The American Journal of Surgery

EDITED BY

Thurston Scott Welton, M.D., F.A.C.S.

SYMPOSIUM

Office and Minor Surgery and Hospital Procedures

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December 1940

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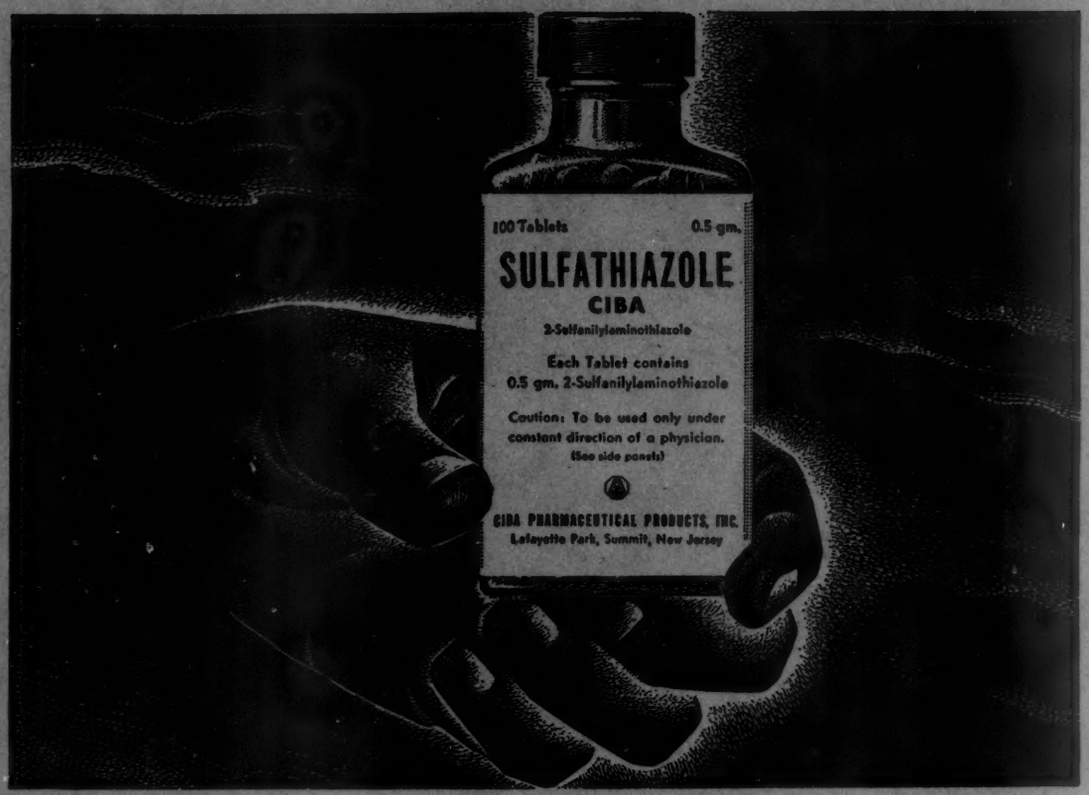

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The Rationale of Suture Use

BRIEF DISCUSSIONS BASED ON REPORTS OF CURRENT RESEARCH AND CLINICAL OBSERVATION

The Immediate Strength of the Sutured Wound

The immediate strength of the sutured wound depends more on the character of the tissues sutured, the number of sutures used, and the manner in which they are placed in the tissues than on the thread strength of the sutures employed.

Suturing fascia provides the greatest amount of strength for the wound while the suturing of muscle and fat provides little or no strength. Increasing the number of interrupted sutures used, instead of increasing the size of the suture, produces greater wound strength. When the sutures employed pull at right angles to the major alignment of the tissue fibers, the greatest holding power of the tissues for sutures is obtained.

Although sutures lose some strength through wetting and knotting when placed in the wound, this loss is not always proportional to the original dry strengths of the sutures. Within the wound, therefore, some of the smaller sizes of sutures have strengths comparable to the larger ones. But even after this loss of strength has occurred, with wetting and knotting, the remaining or functionating strength of sutures larger than size 0 exceeds the holding power of the tissues for the sutures.

The holding power of the tissues for the sutures, then, really determines the immediate strength of the wound if sutures larger than size 0 are used. Conversely, the maximal immediate strength of the wound can be obtained by using size 0. The use of the finer size of suture will minimize the complications of wound healing often encountered with larger ones.

Bibliography or answers to specific questions on this subject will be sent on request. DAVIS & GECK, INC., *Brooklyn, N. Y.*

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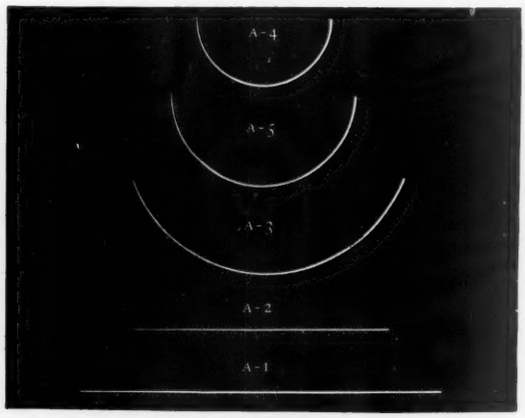

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1669	Mild chromic–type B, B-5	18″	4-0, 3-0
1669D	Mild chromic–type B, B-5	9″	4-0, 3-0

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1662	Black silk, B-3	12″	6-0
1664	Black silk, B-1	12″	6-0, 4-0
1666	Plain–type A catgut, B-4	12″	3-0
1668	Mild chromic–type B, B-5	12″	4-0, 3-0
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1652	Kal-dermic, B-5	18″	4-0, 00
1653	Black silkworm gut, B-1	14″	4-0
1655	Kal-dermic, B-2	18″	4-0
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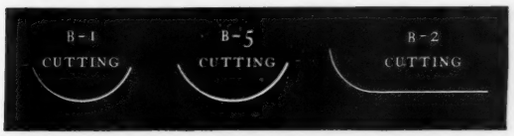

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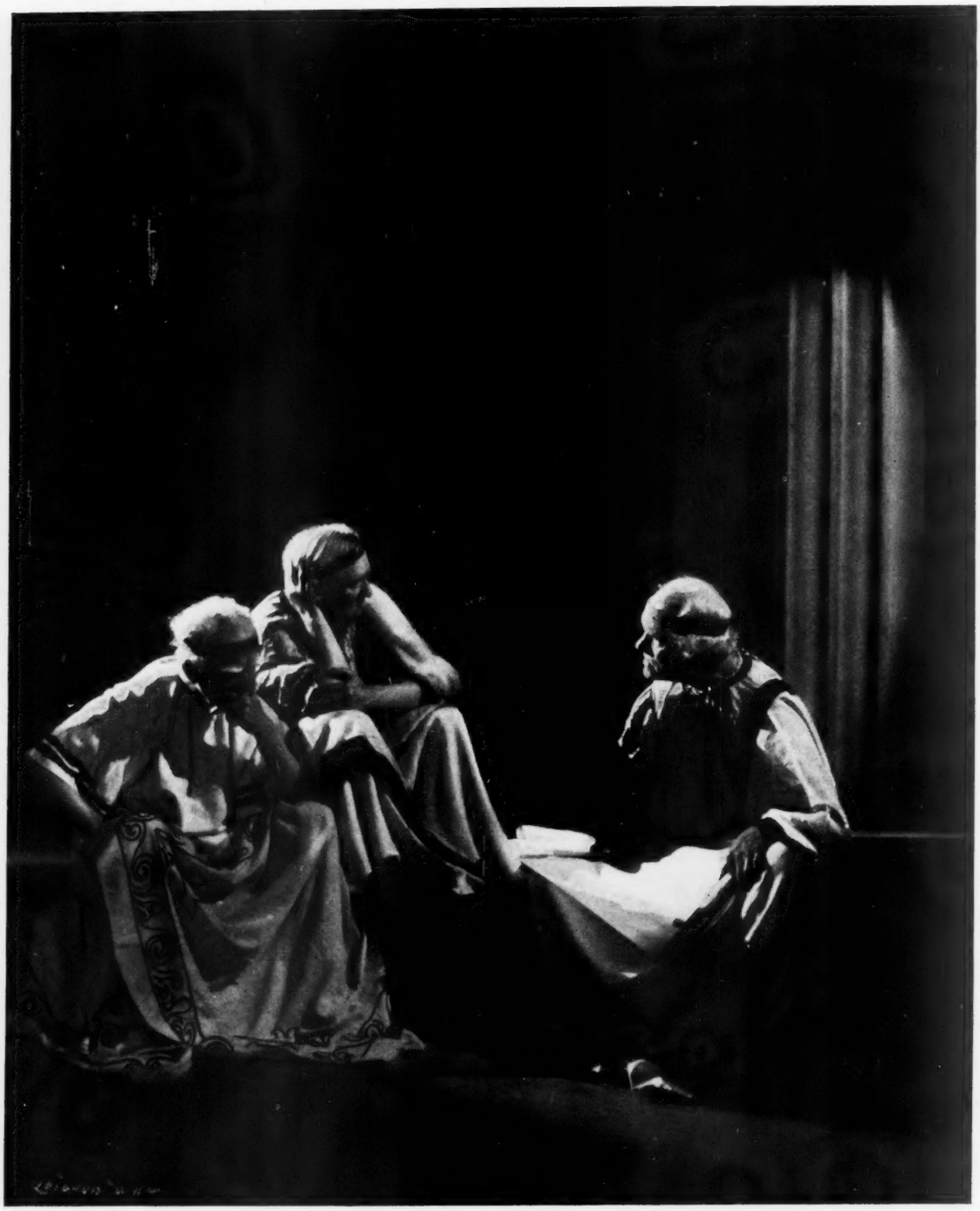

RUFUS OF EPHESUS came to Rome during the reign of Trajan (98-117 A. D.). His works mention that traumatic aneurysm may result from wounds of the arteries, and discuss various methods of hemostasis. These include digital pressure, pressure by bandage, astringents, torsion, cold, applications, and complete severence of incised or eroded vessels. Bleeding of the larger vessels was controlled with ligatures. Caustics were resorted to only in putrid or gangrenous wounds.

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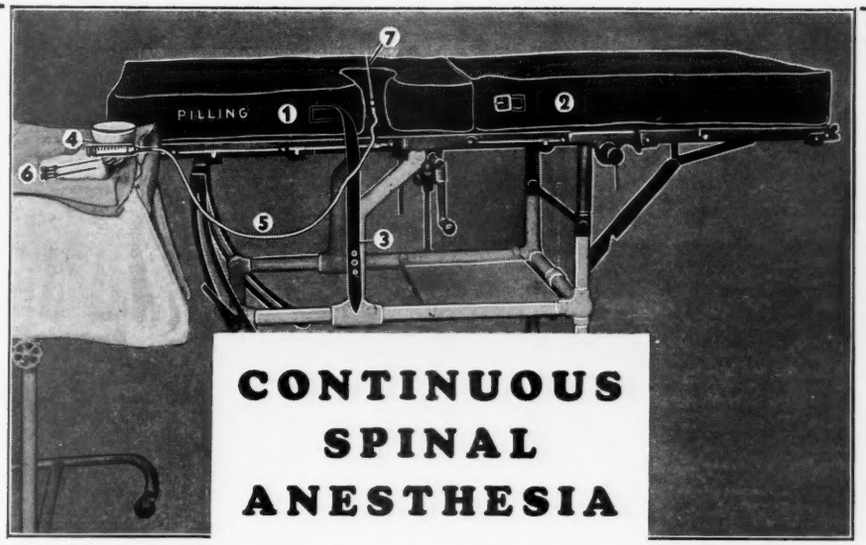

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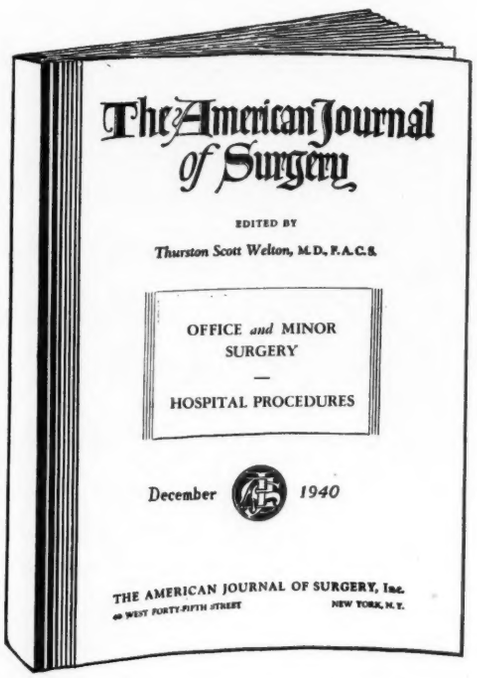

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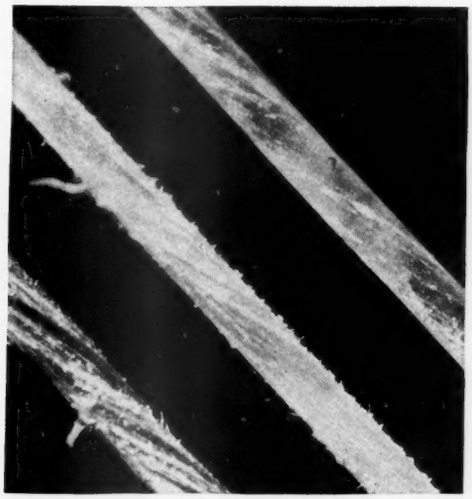

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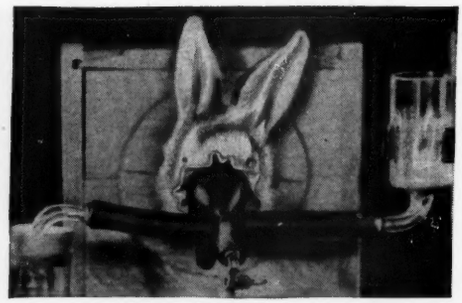

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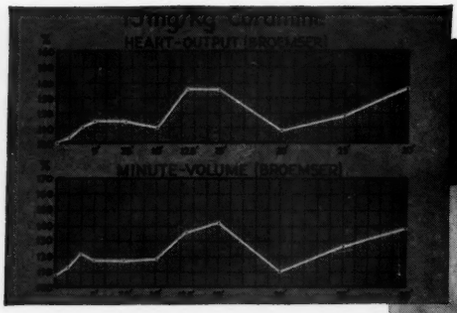

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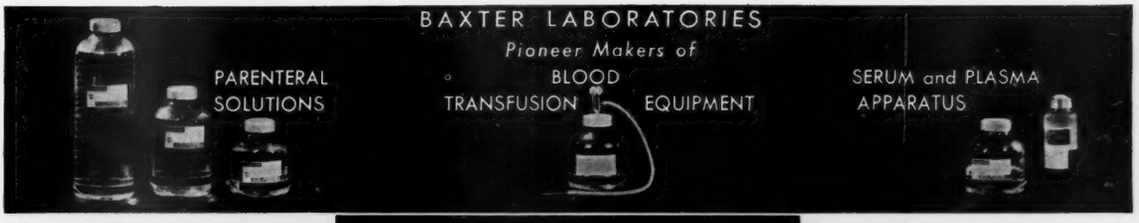

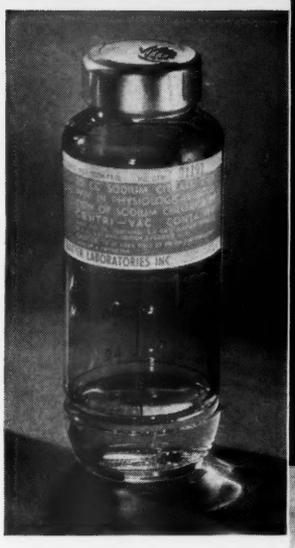

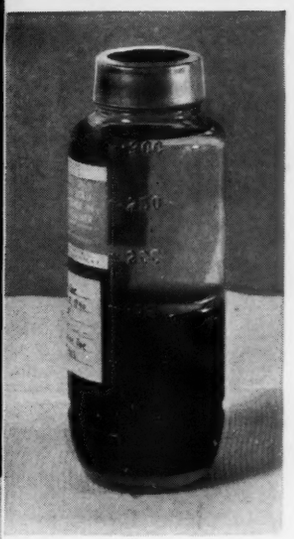

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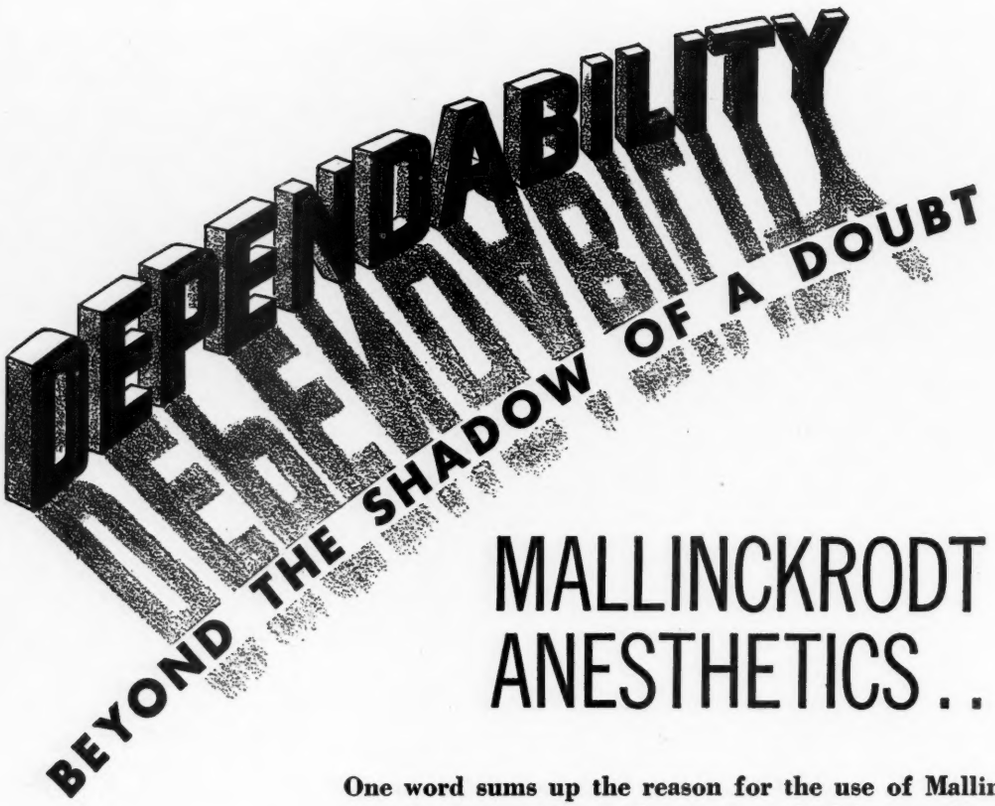

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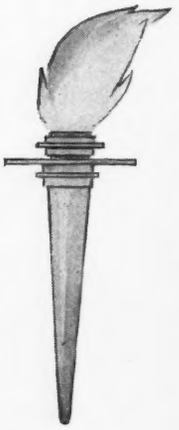

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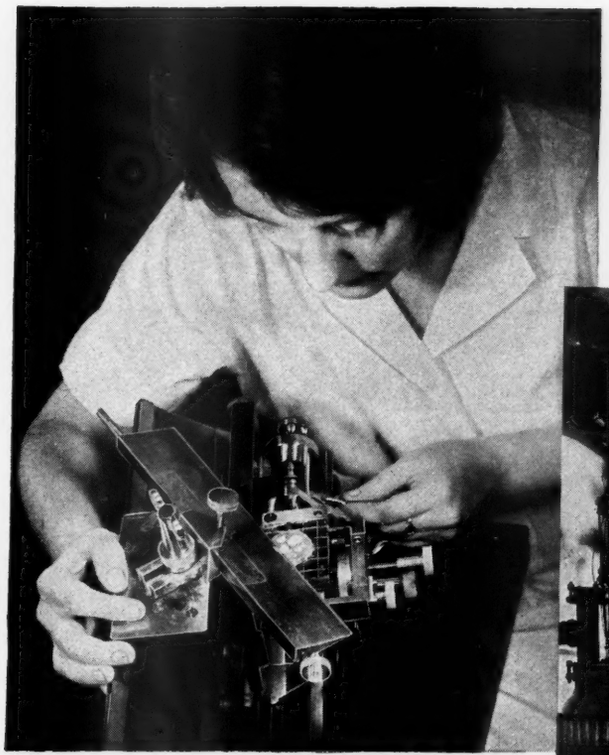

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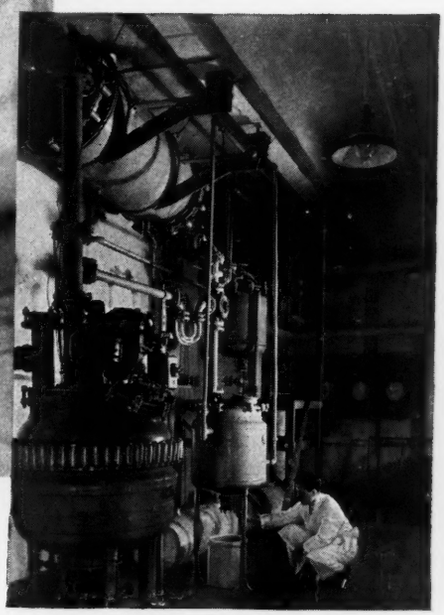

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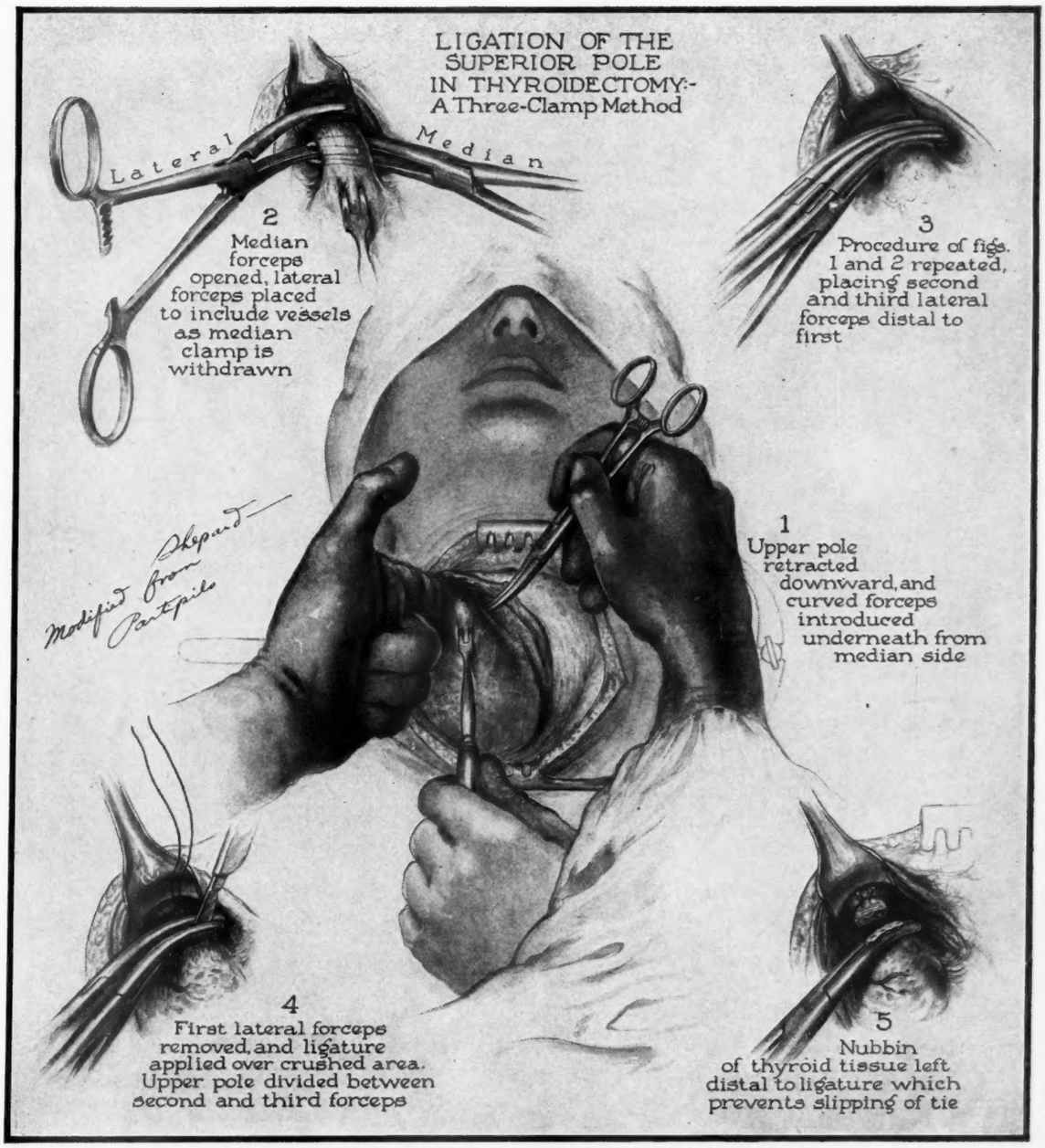
LIGATION OF THE SUPERIOR POLE IN THYROIDECTOMY:- A Three-Clamp Method
Lateral
Median
2
Median forceps opened, lateral forceps placed to include vessels as median clamp is withdrawn
3
Procedure of figs. 1 and 2 repeated, placing second and third lateral forceps distal to first
Modified from Shepard Partipilo
1
Upper pole retracted downward, and curved forceps introduced underneath from median side
4
First lateral forceps removed, and ligature applied over crushed area. Upper pole divided between second and third forceps
5
Nubbin of thyroid tissue left distal to ligature which prevents slipping of tie

OPERATIVE PROCEDURE—PLATE NO. 112—COPYRIGHT 1940, JOHNSON & JOHNSON

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NEW SERIES, VOL. L DECEMBER, 1940 NO. 3

The American Journal of Surgery

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A PRACTICAL JOURNAL BUILT ON MERIT

EDITORIALS

WHAT IS MINOR SURGERY?

FOR the past few years there has been a constant demand from the medical and legal professions and the judiciary for a definition of minor surgery. Attempts have been made to differentiate between major and minor procedures by hospital authorities mainly for the purpose of financial classification of the patient. There is no definite demarcation between minor and major procedures. This differentiation is governed by the type of hospital. In order to reach a definition of minor surgery various groups were consulted for their interpretation. The following are some of the accepted definitions of minor surgery:

The Board of Regents of the University of the State of New York adopted the following on July 28, 1939: "The phrase 'minor surgical procedures,' as used in the law, shall be construed to include all surgical procedures excepting those involved in incision for: the opening of a natural body cavity, the removal of benign or malignant tumors, bone fractures, the amputation of an extremity or an appendage, the removal of any gland or organ or part thereof, or plastic surgery of the human body."

In the preface of Dr. Frederick Christopher's textbook on minor surgery he gives the following definition: "Minor Surgery is the surgery which has a low mortality; which requires but few assistants; which generally is done in the hospital out-patient department or in the office. It includes the large majority of surgical cases; the everyday surgical conditions. *All minor surgery potentially is major surgery; often a distinction cannot be made.*"

Doctor T. R. Ponton, Editor of *Hospital Management*, in December, 1937, after studying the subject, stated: "There can be no rigid definition of major or minor surgery. In fact, it is very doubtful if the terms are not misnomers except from the financial point of view. Looking at the question from the professional aspect, it must be acknowledged that there are few operations which require so slight a degree of skill in their performance as to warrant the use of minor classification. When the risk to the patient is considered, the use of the term major must be applied to all surgery in which, for any cause whatever, there is a serious risk to life or grave danger of disability, whereas in the minor case, these hazards are slight."

Doctor MacEachern in *Medical Records in the Hospital*, lists the five points which classify an operation as minor:

"*a.* The abnormal condition which indicated the operation is such that, in itself, it constitutes no serious hazard to the life of the patient.

"*b.* The patient shows no other abnormality which, added to the condition

indicating operation, would constitute a serious hazard to life.

"*c.* The operation is not of an extensive or complicated nature and requires only simple equipment, a minimum of assistance and a short period of time.

"*d.* The surgeon is sufficiently trained and experienced in the particular type of operation to be performed to obviate the addition of any hazard to the life of the patient.

"*e.* If an anesthetic is necessary or advisable, it should not be of a deep and lasting nature, should be selected with care and should be administered by an anesthetist who is skilled in administration of the particular types of anesthesia."

It is apparent from the foregoing interpretations that there is no minor surgery. A superficial infection of the nose may terminate in meningitis or brain abscess (example cited by *Medical Times* of October, 1938). Any break in the continuity of the skin may end in an infection of the blood stream. A so-called minor procedure in a diabetic patient may terminate in an extensive operation and possibly death. A simple tonsillectomy in hemophiliacs may result in a serious risk to life. Anesthesia for minor procedures is also responsible for a considerable number of fatalities. A simple spontaneous delivery, forceps or version may lead to puerperal sepsis, rupture of the uterus and other complications. A simple curettage of the uterus may cause perforation with possible hemorrhage or peritonitis. Again we must not lose sight of the surgeon's skill in the operative procedure. The time element, the knowledge of the special field of surgery and the individual technical ability may sometimes make a minor procedure a major operation.

The only possible distinction that can be made between minor and major surgery has to do with the cost of hospitalization. This is arbitrary and depends upon the respective locality and type of hospital administration. When the risk to the patient is considered, surgery is surgery, and any attempt at definition of a minor procedure is entirely out of order. I fully agree with Dr. Hubert A. Royster, who states, "that the term minor surgery should be eliminated from the nomenclature." Of 104 surgeons whom Dr. Royster consulted only one disagreed with this opinion. Personal communications with the respective American Boards are in accord with this idea.

It is impracticable, therefore, to classify operations as major or minor. There is no authoritative classification of this nature published except as a guide to the hospitals in the determination of hospital costs. We do not invoke the latter when the purely surgical interest of the patient is considered. In the interest of the public it becomes a necessity for the medical profession at large to make an attempt properly to classify procedures so that practitioners of medicine with limited privileges can become acquainted with their limitations, and that the judiciary can refer to some authority when interpreting the law. It is, therefore, our duty to supply such a classification.

Vincent P. Mazzola, M.D.

WHO KNOWS?

THIS special number is the result of many requests that we again publish short, practical articles on so-called minor surgical procedures. In the foregoing editorial the reader will be impressed with the fact that the term, "minor surgery," is a misnomer. Much has been written on this subject, but to date a true definition has not been given. In this, the third special issue on minor surgery published by us, the term has been used for the want of a better name.

Physicians have a loose idea as to what constitutes minor procedures, but the Courts often have to arrive at a definition and so far have looked to us in vain to

supply their want. Roughly, any surgical procedure is major unless the operator has had an adequate medical training (graduate of a recognized school of medicine). In other words, only one with a medical degree and licensed to practice has a legal right to do surgery. In this sense, surgery covers the field from the most simple to the most involved procedures. The cultist and member of a healing field outside of medicine, as it is legally defined, cannot do even the so-called minor procedures, because he has not had the basic training and surgical background. To the doctor of medicine with the legal right to do surgery, the thing resolves itself down to the ability and limitation of the individual. The recognized gynecologist, for example, looks upon a diagnostic curettage as a minor operation. To the general practitioner with scant experience in this field it looms as a major operation.

For the Court's benefit we would say that any procedure that calls for incision, excision, suturing, injection or an anesthetic of any type in order to make the procedure possible, is not minor surgery. In this case all surgery is major surgery. In a later issue Dr. Mazzola will list the various so-called minor procedures as given to him by a representative of the various Boards in the surgical specialities. A few years from now, another issue similar to this may be published on minor surgery. If anyone has a title for it—an apt title—we should appreciate having it.

T. S. W.

ORIGINAL ARTICLES

THE TREATMENT OF INTRACTABLE PAIN

R. J. BEHAN, M.D., F.A.C.S.

Surgeon, St. Joseph's Hospital, Pittsburgh, and City Home and Hospital, Mayview; Medical Director and Chest Surgeon, A.C.I.D. Hospitals, Woodville

PITTSBURGH, PENNSYLVANIA

THE term, intractable pain, is frequently used, and it seems necessary that a definition should be formulated so that when intractable pain is mentioned we may know what is meant. Intractable pain may be regarded as a pain which requires the constant administration of sedatives and narcotics, such as morphine, etc., without any continued ameliorating effect. It resists all efforts of cure, becomes a scourge and a torment to the afflicted person and a problem of worry and concern to the attending physician. It usually keeps the patient awake at night and so disturbs mental and physical reactions that the sufferer is unable to carry on his usual work and becomes an early victim to disease and misfortune. The degree of pain and criteria of the effect of treatment may be judged by the afflicted person's ability to enter spontaneous sleep without sedatives.

If time and a more systemitized investigation is necessary to obtain a better conception of the causative factors, the patient with severe and intractable pain should be hospitalized until the attending physician is sure of the actuality and the degree of the pain and its relationship, if any, to physical changes and bodily functions. This understanding is necessary because in the uncertainty and turmoil of present day conditions, the psychic stamina of many individuals seems to be so reduced that abnormal and bizarre reactions occur to weak and otherwise unimportant stimuli. A disturbed psyche frequently is associated with a craving for sympathy so that in many instances, when cravings are unappeased, the patient's impressions are sublimated and are ordinated into sensations of pain. In such conditions, narcotics and sedatives are sought as a means of relief. Subconscious fear of disease such as cancer, etc., will also lower the central threshold for sensory impressions and lead to pain.

Because of its hold on consciousness and its reflex devastating effect, surcease from pain is essential in the therapeutics of several diseases, such as coronary heart disease and pneumonia. In such cases sturdy efforts should be made towards its relief.

A clearer concept of the factors involved in the production of pain and the measures useful in its relief is of importance when we consider the many times that pain has been the unrecognized pernicious factor involved in horrible judgments leading to actions pregnant with misery and distress. Personal and national calamities at times may be the result of the hidden motivations evolved by the abnormal processes of a mind distorted by pain. It is self apparent that headache, throbbing with the thumping of demons working in disordered clamor as was so clearly defined by Hogart, is not conducive to clear thinking and lucid decision.

It is reasonable to suppose that pain is apt to produce a state of mind which is unfavorable to the making of elemental decisions and it is also conceivable that the distress caused by intractable pain may lead to unmerited determinations in which the psychic equivalents of sadist desires are

hidden. These hidden motivations act as compelling factors in the formulation of actions and clarify deeds which otherwise are unexplainable. Headache alone has lead to disaster and it is said that the hemorrhoids of Napolean lost the battle of Waterloo.

The significance and the importance of pain as a factor in diagnosis is not to be minimized nor, on the other hand, are we to be deceived by misleading statements of the severity and quality of the pain. We should not be influenced by complaints from the patient as to its intensity and constancy. If the appearance and complacency of the sufferer belies the emphasis placed by him on his anguish and distress, we must be cautious in our evaluations but should not discount all the statements of the patient.

In many cases it may be necessary to determine if any pain is present. Should the examiner be convinced of its actuality, it is his duty to evaluate its severity and know how far he can proceed in any particular case on the assumption that pain is feigned. If not actually imagined, pain may be a psychic termination of the activity of a mass of subconscious impressions, or, in a vicarious manner, it may be the result of correlated subconscious reactions constantly striving for acknowledgment in the realm of actuality.

The fear component with its acute apprehensive expectancy may be so active that the least touch or physical reaction which penetrates to the sensorium will instantly produce an acute sensation which may be misinterpreted as painful. These patients should be assured and convinced by logical reasons by a physician who has gained their confidence—and confidence is not obtained by antagonism—that their sensations while real have become magnified and at times may actually be mistakenly interpreted by their own apprehensive fears.

Patients of the character described above, who are subject to intensive complaints of pain, may not even be influenced by large quantities of narcotic drugs such as morphine. The acute manifestations may be overcome by central physical depressants as bromides, barbiturates or by psychotherapy. Great care should be exercised by the physician that the increased interest which is directed towards the patient's attitudes and symptoms does not so engraft these attitudes and symptoms that they become fixed and occupy the mind and consciousness of the patient to the exclusion of other signs and symptoms more indicative of the pathologic lesions from which he is suffering.

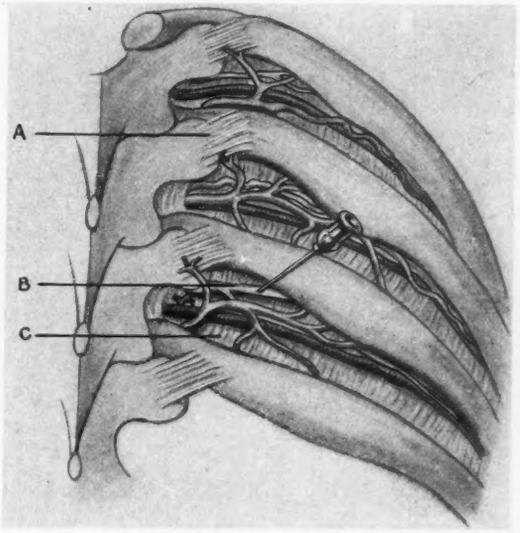

Fig. 1. This figure shows the method of injection into the intercostal nerves for the relief of pain in intercostal neuralgia. A, ligamentum tuberculi costal; B, intercostal nerve; C, membrane intercostales posterior. The figure reveals the three intercostal spaces with their contents, the nerve, the artery and the vein. The external intercostal muscle has been removed. The posterior intercostal membrane and the internal intercostal muscle are intact.

In the treatment of individuals such as these, the absolute need is a change in the attitude of the patient toward himself so that he can be led as far as possible into a state of sensory abnegation in which physical reactions are not stressed in psychical terms of his own physical integrity. On the contrary, psychical exaltation of his ego into a phase of mental exaltation will expel harmful impressions from his consciousness. This should be the aim of his physician.

In such persons, purposeful mental and physical activity with definite and planned

design must be substituted for inactivity or abnormal activity of mind and of body. An attempt should also be made to correct the disturbed mental state by improving environmental productive factors.

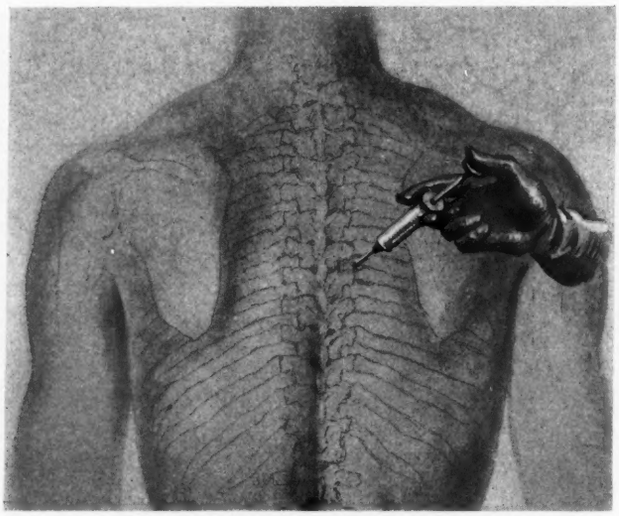

FIG. 2. Illustration shows method of insertion and direction of insertion of needle in paravertebral injection.

In all cases of intractable pain the patient-quotient as a factor in the production of the pain must be evaluated and all pernicious influences, instrumental in its production should be eliminated. When this is possible, intractable pain may gradually disappear.

It is of extreme importance for the welfare of the patients with intractable pain that the medical attendant never become irritated nor should he be peeved if his efforts to ameliorate the patient's complaints are unsuccessful; neither should he regard himself as free to express doubt of the results of his treatment nor should he show irresolution in the handling of patients complaining of pain. Any confusion or apparent lack of confidence on the part of the medical advisor usually is reflected by redoubled exaggeration and intensification of the patient's symptoms.

As a preliminary to more direct treatment, allergies, anxiety states, etc., should be sought and eliminated. When a person complains of pain which interrupts his daily activity and disturbs the repose of his sleep, it does not suffice for sincerity of purpose of the physician or for release from misery of the affected, for the medical consultant to tell the suffering individual that his pain is really not present but is a figment of his imagination. Even though the doctor may be sincere in the honesty of such a judgment, the patient knows that in many cases it is, as he says, "a lot of hooey." He is more than dimly conscious that frequently the doctor may be burying his head in the folds of his own ignorance. The patient himself knows that he has pain and that it is real, because he feels it and will not believe anyone who claims that he has no pain, and that is the point of this discussion. It makes no difference to the patient whether his sensation of pain is due to imaginary projections or is the result of central, complex and hidden causes, as long as he feels it, the pain is real. Therefore, in every case in which pain is perceived, it is necessary that immediate measures be taken by the medical attendant for its relief. Irrespective of how intelligent or how cooperative the patient may try to be, he is more insistent in his clamor for the immediate relief of his pain than he is for the discovery of its cause.

For this reason, while investigations are being continued to determine the cause of the pain, measures should be instituted for its relief. If a pain is intractable to treat-

ment or if it does improve with treatment and then returns, it means that the factors causing the pain are still operative, or that the recuperative processes instituted by the patient against these factors are not constant. However, when the pain cannot be relieved or returns after temporary relief, the physician should not permit himself to be so influenced by the clamor and the pleadings of the patient for relief, as to be stampeded into using means and remedies which are unjustified. He should balance therapeutic benefits against danger to life, the production of serious anatomic defects or the loss of function which would be disabling and unbearable in its distress. This is all the more significant because in some cases as time goes on and ameliorating treatment is applied, it is surprising to note that the pain may tend to disappear or change to another type which is more amenable to treatment. In due time the cause of the pain will be established and the pain can then be relieved. In every case, haste should be made slowly. In many instances, strange as it may seem, irrespective of the fact that the causes of the pain are not discovered nor corrected, the pain itself gradually disappears, possibly because in some manner the measures instituted for the relief of pain may indirectly have removed or modified the cause of the pain.

In the quest for the causative factors producing the pain, we should remember that pain may be due to derangement in the central sensory pain reception areas or to disturbances in the conducting or perceptive apparatus. The onset and the continuation of a pain should be regarded as the result of maladjustments in the mechanical, chemical or functional activities of the various organs of the body.

Pain of central perceptive origin may arise in the cerebrospinal central nervous system or be a result of derangement in the complimentary sympathetic nervous system either in the ganglia, the conducting apparatus or the cerebral sympathetic nerve centers (tuber cinereum).

Intractable pain may occur in any of the following components:

- Central pain
  - psychogenic
  - vasomotor
  - thalamic
- Nerve conduction of pain
  - somatic nervous system
    - sympathetic nervous system
  - traction on nerves
    - amputation
    - scars—perineurial
  - pressure on nerves
    - injections, etc.
  - inflammation
  - anatomic derangement
  - anemia
- Reception area of pain
  - ischemia
  - toxic poisons
  - exposure of nerve endings
  - nonisotonic tissue juices
- Referred pain
  - viscera
    - heart, angina
    - lung
    - liver
    - gallbladder
    - stomach and intestine
    - rectum
    - genitourinary
  - (a) colic
  - (b) peritoneal
  - sinuses
    - frontal
    - ethmoidal
    - maxillary
    - mastoid

Pain of central origin may be either *psychic* or *organic*.

Psychogenic pain is subjective, in that it arises without objective irritation. It is the result of psychic maladjustment. The psychopath as a rule is so possessed by his own introspective conceptions that he is indifferent to exterior influences. Such an individual does not resent the imputation that the pain of which he complains does not exist, and in many instances he is apathetic and is not interested whether the findings of the examining physician do or do not corroborate his complaints. The malingerer, on the other hand, is very anxious that the

symptoms and reactions elicited by the medical examiner support the pattern of the symptoms he has elaborated.

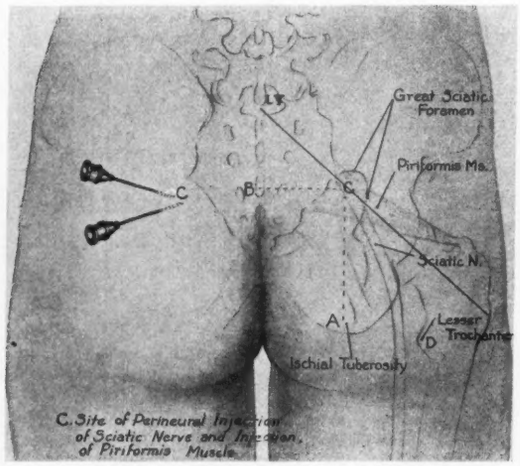

FIG. 3. Technic of perineural injection of the sciatic nerve as it emerges through the greater sciatic foramen. The intersection of the dotted lines and the line drawn from the femoral trochanter to the fifth lumbar spinous process indicates the point at which the needles are introduced. (From Haggart, G. E. Sciatic Pain. *J. Bone & Joint Surg.*, 20: 851, 1938.)

This indifference which the subject with psychogenic pain has to the results of physical investigations is due to the fact that the pain of which he complains is of central origin and the factors inducing it are not changed by peripheral sensory impressions. At times, in such cases, it is difficult to determine whether pain is actually present.

If pain is actually present, it will be accompanied by one or more of the following conditions: Elevation of blood pressure, motor reflexes causing contraction of muscles in or over the painful area, changes in facial expression, dilatation of the pupils, pallor and syncope, increasing rapidity of the pulse and more rapid and shallower breathing.

Functional changes in the central nervous system instrumental in causing pain may be due to vasomotor disturbances which produce a congestion or an anemia of the brain tissues. Pains due to circulatory disturbances are usually manifested in the form of headache. If headaches are persistent and constant in their intensity and location it is an indication that the causative factors are persistently active. When we have this information, it is necessary to look for such factors.

Headache due to cerebral hyperemia is associated with a flushed face and hot skin. Sitting or standing will relieve the headache; declining in a prone position will increase it. In this condition drugs acting upon and stimulating the sympathetic nervous system will correct the oversupply of blood, reduce the turgidity of the tissues and decrease intracranial pressure.

The opposite is true in vasoconstrictor headaches, the best example of which is migraine. Almost acting as a specific in this condition is acetylcholine which paralyzes the sympathetic nervous system and thereby allows the peripheral vessels to dilate and increase the circulation. Ethylcholorine inhalations or inhalations of amyl nitrite have somewhat the same effect but are very evanescent. A simple treatment which many years ago I began to use in any kind of headache, due to almost any cause, is a reduction of the skin temperatures of the affected areas by the application of ice or of ether dropped on or sprayed on the skin. Spraying of the skin area to which pain is referred with ethyl chloride is also effective. The dropping of ether on the skin with evaporation, which is increased by blowing with a fan, has also proved effective in the headache following spinal anesthesia. It appears that desensitization of the skin areas in which the pain of headache is felt also has some indirect influence in alleviating the cause of the headache, for after the effect of the cold on the skin has subsided, the headache may not return. The pain of headache can in most instances be relieved by the subcutaneous injection of novocaine solution into the tender skin areas. Chronic headache due to systemic causes must be treated by correcting the systemic derangement such as anemia, toxemia, etc.

Head Pain of Organic Origin. If the pain is due to a lesion in the central pain perceptive areas, as in the thalamus, the

impossibility of relief has been repeatedly demonstrated.

Intractable head pain due to increased intracranial pressure, such as would be produced by intracranial tumors, are extremely difficult to relieve. Acetanilid or its combination with phenacetin has been of service. Morphine sulfate, even though it is habit forming, is justified. Migraine frequently is associated with and is increased by high blood pressure which should be reduced. Ergotamine tartrate is used for this purpose; all reflex causes for headache should be eliminated.

Drugs or Other Substances Acting on the Cerebrum. These drugs must reduce the receptive sensitivity of the cerebral cells receiving the pain producing impulses. One of these substances which recently has been greatly extolled is cobra venom. There has been considerable controversy over the efficacy of cobra venom in the relief of pain. According to Macht,[1] the action is central upon the cells of the cerebrum. It has been recommended particularly in cancer.

Dose. The initial intramuscular injection is 1 cc. or 5 mouse units. This dose is followed on each succeeding day or every other day by at least 50 mouse units. As soon as the subjective symptoms decrease, the dosage is reduced.[2] The sites of injection are alternated, and no effect is expected until five or more injections are given.

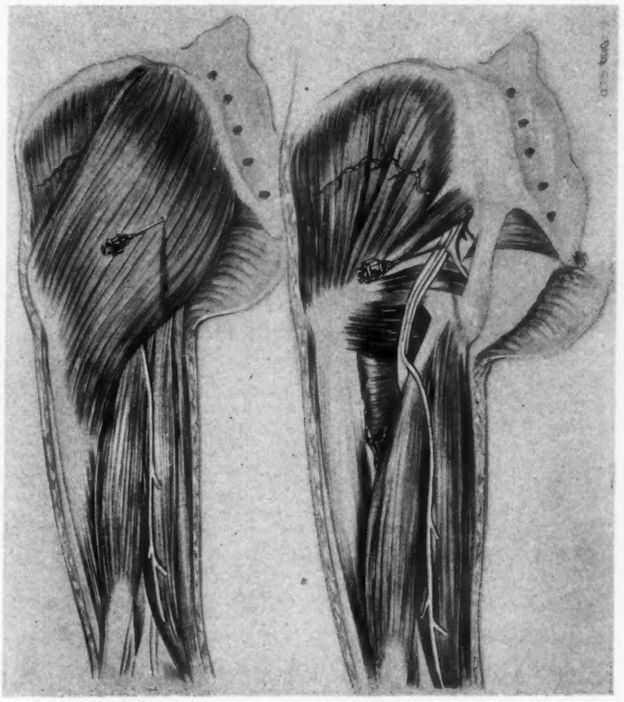

Fig. 4. Diagram showing site of injection and approximately the area which the tip of the needle penetrates for injection of sciatic nerve at the greater sciatic notch.

Cobra venom was injected subcutaneously at intervals of two days and in doses up to 25 mouse units in ten patients with advanced genital cancer. In two cases there was complete cessation of pain. In the other eight, there was a lessening of the pain in varying degrees. No effect was noticed, especially gastrointestinal symptoms. The conclusion is drawn that cobra venom has no advantages over the ordinary analgesics, especially morphine.[3]

Cobra venom has also been used in the treatment of the pain of arthritis, osteoarthritis, tabetic crises, uncontrollable neuralgia, sciatica, tic douloureux and myofascitis. Other central acting anesthetic agents which are better known are

morphine, the barbiturates, the bromides, etc.

The abatement of intractable pain by limiting or abolishing the perceptive centers in the cerebrum by narcotizing drugs is to be condoned only when all other means have been tried and have been found ineffective. It is especially to be recommended that during the period when attempts are being made to determine the cause of the pain, the pain itself should be controlled by means of drugs (narcotic or sedative), mechanical measures producing rest or alleviation of muscular or ligamentous strain, localized injection of desensitizing substances or surgical interruption of the pain conducting fibers.

Drugs acting centrally on the pain perceptive centers in the brain should be used with extreme caution. Such drugs are usually opium derivatives, such as morphine, pantopon, dilaudid, etc., or derivatives of cannabis indica.

To all patients with intractable pain there is a universal disinclination and hesitancy of the medical attendant to give morphine because of the fear that a habit may be formed; but, contrary to what is regarded as the usual result, it has been my experience that when pain for which morphine is given ceases, the craving usually is corrected. In fact, the craving for morphine frequently represents the desire of the subject to remove himself from the sphere of the disagreeable to the dreamland of the unreal. In some instances this may be desirable. In all cases care should be exercised in prescribing morphine, for no one can tell whether the moral stamina of the one to whom morphine is given is sufficiently sturdy to voluntarily correct his tendencies and desires, when the cause for which the morphine is given is removed.

In selecting narcotic drugs, the nonhabit forming ones should be chosen. In this choice care should be exercised that drugs to which the patient is allergic are not given, or that drugs such as aminopyrine should not be too long continued without a close inspection of the morphology of the blood (agranulocytosis is an indication that the drug should be stopped).

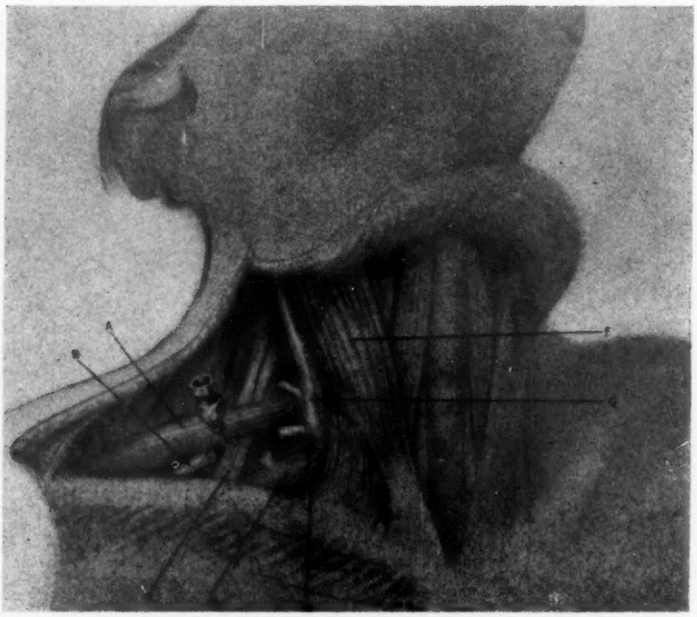

FIG. 5. Diagram showing the location and direction of the needle for injection of the brachial plexus. A, omohyoid muscle; B, transverse cervical artery; C, brachial plexus; D, subclavian artery; E, scalenus anticus; F, sternomastoid muscle; and G, internal carotid artery. (From Behan, R. J. Cancer. P. 490. St. Louis, Mo., 1938. C. V. Mosby Company.)

In the class of drugs most reliable in producing central sedation in long continued and intractable pain, are the bromides and the barbiturates. From his investigations, Barnett Alpert[4] concluded that bromides are preferable to any barbiturate; they are not habit forming and do not produce tolerance. Phenacetin and amidopyrine are also useful as is chloral hydrate which may be used alone or in combination with the bromides. Proteins, heat and fever therapy have in many instances been found valuable.

Vitamin deficiency, especially that of the B complex, has been considered a factor in increasing the sensitivity of tissues; for this reason, B complex should be tried in all conditions where pain occurs from weak and ordinarily unproductive stimuli.

Vitamin deficiency, especially the deficiency of the vitamin B complex, also is frequently a factor in the occurrence of peripheral neuritis (beriberi), the neuritis of pregnancy and the neuritis due to alcohol, lead, diabetes, etc. Vitamin B_1 (thiamin chloride) or the B complex should be given to every patient suffering from intractable pain. In the treatment of the pains of tabes dorsalis, good results from the use of vitamin B_1 were obtained by Metildi.[5]

Spinal Cord Lesions. Lesions of the spinal cord producing pain are not amenable to nonoperative treatment. In lesions peripheral to the cord involving the posterior roots or the ganglia, or sensory nerves distal to the roots and ganglia, a subdural injection of alcohol is of value.

Drugs Acting upon the Synapses. Calcium in the form of gluconate has been used as a means of controlling pain. Calcium gluconate for pain in cancer was first advocated by the author in a paper read before the Buffalo Academy of Medicine in 1926, and one read a year earlier before the Allegheny County Medical Society, Pittsburgh Medical Bulletin, June 20, 1925.[6,7]

In a discussion of E. E. Downs' paper[8] on "Care of the Cancer Patient" at the thirty-seventh annual meeting of the American Roentgen Ray Society at Cleveland, Ohio, 1936, Dr. Kenneth D. A. Allen, of Denver, Colorado, agrees with Dr. Downs that calcium gluconate and dilaudid are very useful. Calcium gluconate is of value in the control of the pain. Dilauded in small doses is of great benefit. It may take the place of morphine and will be effective in smaller doses.

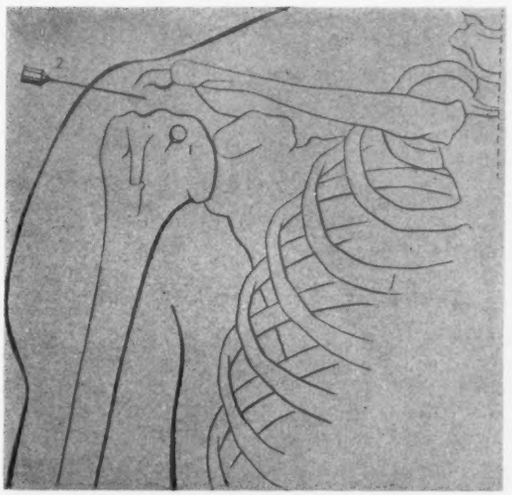

Fig. 6. Needle, 1, is entered directly anteroposteriorly, to reach the head of the humerus the projection of which is easily determined by palpation. Needle, 2, is entered lateromedially, below the external border of the acromion, in the hollow which separates the acromion from the head of the humerus; it reaches the subdeltoid bursa. (From Atlas of 25 Points for Local Injections. 2nd Edition, p. 15. Paris, France. Midy Laboratories.)

Acetylcholine, which acts upon the synapses, in doses of 0.1 to 0.2 Gm. is of great benefit in the condition called causalgia, in which the resulting neuralgiform pain is out of all proportion to the slight injury to the nerves of the extremities, especially the median, the cubital and the internal popliteal nerves. In such cases it may be necessary to continue daily injections of acetylcholine in order to control the pain. In patients with arteriosclerosis the improvement is at best only temporary.[9–11]

In preference to drugs and other narcotizing substances, reliance should be placed as much as is possible upon accessory

methods of treatment which are directed towards removing the cause of the pain. In toothache the pain is corrected by proper

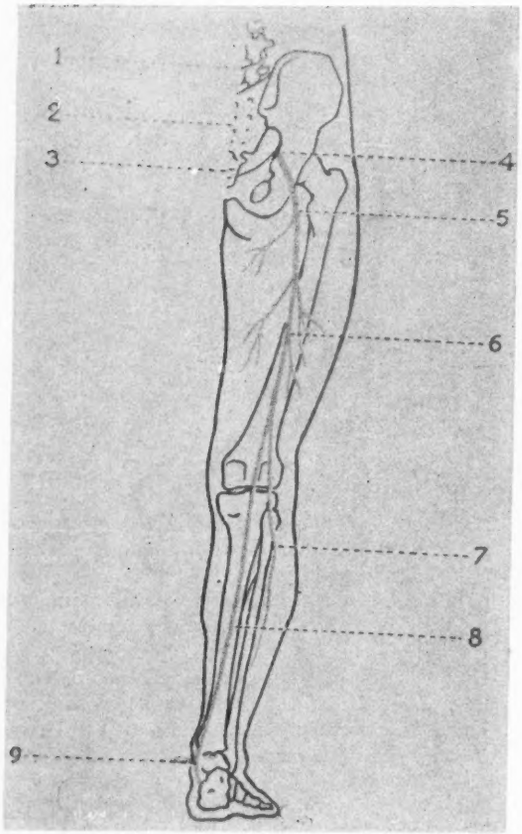

FIG. 7. Points at which injection of the analgesic solutions should be made. It is in these areas that local points of tenderness are present in the sciatic nerve involvement.

1. Infiltration of the superior roots of the sciatic nerve (L^4 and L^5) by paravertebral injections. 2. Infiltration of the inferior roots of the sciatic nerve (sacral roots) by presacral injection. 3. Infiltration of the inferior roots of the sciatic nerve (sacral roots) by epidural injection. 4. Infiltration of the sciatic nerve at its exit from the great sciatic foramen. 5. Infiltration of the sciatic nerve at its entrance into the ischiotrochanteric notch.

dental care. Correction of the pain of pleurisy is obtained by fixation of the chest by strapping with adhesive. In backache, better posture is of great value, etc. In angina pectoris, restriction of effort is necessary. In acute indigestion, gastric lavage produces immediate relief. In infections, the local application of heat or cold in the form of compresses, etc., may be used. In earache, mild anesthetics in solution in oil can be dropped into the ear, but is not to be recommended as it is apt to create a false sense of security. In pain of neuritis and neuralgias, and pain of cryptic origin, vitamin (B complex) should be given and fever and protein therapy should be tried.[12]

Nerves and Nerve Terminals. Drugs acting on the receptive sensory end terminals of the pain conducting pathways may be used to control intractable pain. Most of our efforts to control the local reception of pain impulses have been restricted to the direct application of nerve blocking drugs in proper solution. Of these the first to be used was cocaine, but accidents and even death has followed its use; so that when novocaine (procaine, one seventh as toxic) was introduced, it quickly supplemented the more dangerous drug. If a long continued effect is sought, the anesthetizing agent may be dissolved in oil.

The pains due to toxic absorption are the result of irritation of the terminal sensory receptors by substances in the tissue juices of the painful region.

It is known that increase in the hydrogen ion concentration of the tissue juices increases nerve excitability; a decrease of hydrogen ion concentration decreases excitability. If a change in the composition and chemical reaction of environmental tissue juices occurs, it may be regarded as the possible cause of any pain which may be present. The tissue juices, if of a lowered pH, may be restored to a normal reaction by deep injection of a 0.5 per cent sodium bicarbonate solution into the affected tissues. Such an injection is of value and may be tried especially if the intractable pains occur in muscle tissues. It is also significant that decrease in osmotic pressure diminishes excitability, and increase in osmotic pressure increases it. Histamine dehydrochloride—1 ampule of 1 cc. containing 0.5 Gm. of histamine dehydrochloride in isotonic solution with a hydrogen ion concentration of about 7.0 may be used as a corrective for pain in acute and chronic myalgies and in arthralgias due to acute and chronic peri-

arthritis, etc.[13] Radiations derived from radium decrease excitability of sensory nerve terminals and then destroy it. In this manner pain is relieved.[14]

According to Wiggers, control of pain may be induced by reduction of the conductivity of sensory neurons by (a) pressure (mechanical compression of a sensory nerve which blocks motor axons before it blocks the sensory fibers in the order of fibers which transmit pressure sensation, then colic pain, then heat and then pain). The pressure should be considerable for slight increase in the excitability of axons may be produced by mild prolonged pressure. (b) Cooling which reduces the excitability; warmth, increases excitability. (c) Chemicals and narcotics (novocaine) applied over a segment of a nerve will hinder or absolutely stop the passage of sensory impulses, depending on the strength of the solution. If the impulse passes the narcotized segment, it again assumes its normal intensity.[15–17]

Neuralgias are due to some change in the sensory nerves, which render them so sensitive either in the conduction of pain impulses or in sensory terminal reception that they react with a sensation of pain to minor stimuli. Adhesions are frequently present between the nerve bundles and the nerve sheath; these have been found especially in neuralgias of the larger nerves, as the sciatic, and have been regarded as the cause of the pain which was present.[18] It is not difficult to visualize the disturbing effect which such adhesions would have during locomotion, when changed relationship, due to contraction of muscles and the consequent pull and drag upon the nerves, will cause irritation and pressure.

Because of the ulterior and devastating influence that pain has on moral and physical behavior, it is necessary that neuralgias be overcome as quickly as our means and knowledge will permit. If the pain is not amenable to the usual drugs such as aspirin and the coal tar derivatives, aminopyrine 0.75 Gm. every third hour or acetylsalicylic acid, 0.75 Gm. every third hour may be given; the two may be combined. Dry heat, diathermia, hyperthermia,

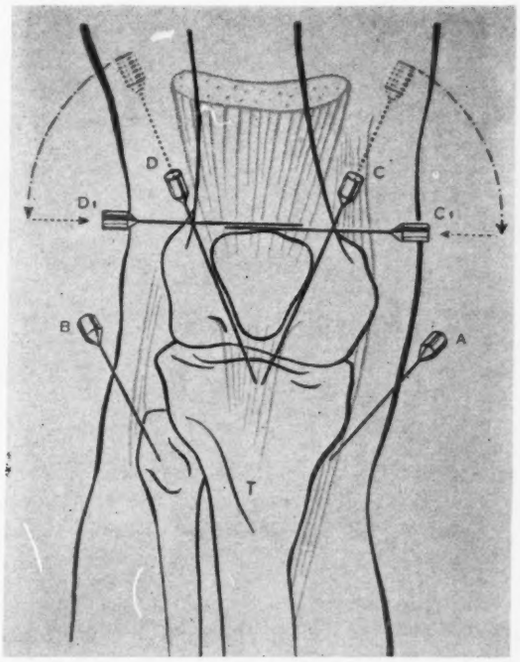

Fig. 8. The points of injection around the knee joint. These points vary depending on the localized tenderness. The solution is injected into the most tender areas. (From Atlas of 25 Points for Local Injections: Thiodocaine. 2nd Edition, p. 13. Paris, France, Midy.)

application of the short wave, local inunctions of nupercaine, salicylates, phenol, menthol, etc., and finally direct injections of analgesics around and even into the nerve should be tried. Injection of analgesic or anesthetizing agents is most effective at the point where the nerve passes through deep fascial layers to become superficial.

One of the most severe and disturbing neuralgias is that of the fifth nerve (trigeminal neuralgia). The pathologic condition producing this condition is more of the type of a radiculitis or ganglionitis than it is of a neuritis and produces the most agonizing pain. Usually it requires destruction of the ganglion of the fifth nerve or section of the posterior sensory roots of the ganglion to relieve the pain. In some cases, however, peripheral desensitization may be of particular value especially when the neuralgic attack is

precipitated by peripheral irritation. A much used desensitizer of the sensory fibers is trichorethylene, a few whiffs of which

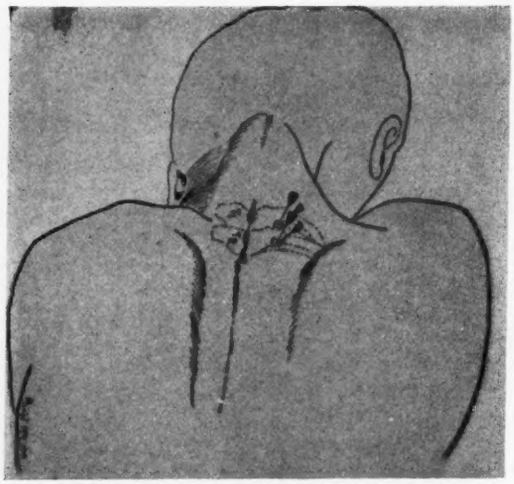

FIG. 9. Points of insertion of the needle, showing the change of direction after the point of the needle has passed the bony resistance of the first rib, or the transverse process of the vertebra. It is then inclined to an angle of 20 degrees to the perpendicular and is inserted to a further distance of 3 cm., or until the resistance to the further insertion of the needle ceases. (From White, James C. Autonomic Nervous System. P. 367. New York, 1935. MacMillan Company.)

does in many, but not all cases, reduce or abolish the trigeminal pain. If only one of the branches of the fifth nerve is involved, direct injection of novocaine into and around the affected nerve will afford relief for a varying period. In some few instances, complete and long continued relief has followed such injection. In a similar manner injection of alcohol (95 or 100 per cent) will bring relief for a longer period; in some cases the relief may be permanent. When alcohol is injected into the Gasserian Ganglion, the method of Hartel or of Schloesser is to be recommended. To render the application as easy as possible I have condensed the technic into the following rules:

1. The proper instruments must be at hand. They consist of:

(a) Two cc. capacity, record syringe.

(b) A 10 cm. long and 0.8 mm. wide steel cannula, heavily nickeled, with a beveled point and a movable clasp.

The needle used by Patrick of Chicago is 12 cm. long and 1.75 mm. thick, a much thicker needle than is Hartel's. The advantage of this latter needle, according to Patrick, is that it is not so liable to break, and the direction of its point can be more easily changed by changing the direction of its base.

(c) A fine cannula for producing wheals in the preliminary skin anesthesia.

(d) A centimeter metal ruler.

2. *Solution:*

(a) For anesthesia, ampules of novocain are used. Braun recommended the addition of epinephrin.

Cocaine (75 per cent) was used by Offerhaus, but this was found to be too dangerous, so that now novocain which is much better and less dangerous is in general use.

(b) For neuralgia, 80 per cent alcohol for injection of the Gasserian ganglion is used. The solution used by Patrick in his first injections for trigeminal anesthesia consists of cocaine hydrochlorate, gr. 1, chloroform ♏ X, alcohol ℥ iii, distilled water ℥ ss. Of this 2 cc. is injected. However, it has been found that all the ingredients except the alcohol are absolutely superfluous.

(c) *Position of the Patient.* The patient lies on a table, with the upper part of the body slightly elevated and a support under the head.

(d) The skin of the cheek over the area of injection is disinfected either with alcohol or with tincture of iodine (5 per cent).

(e) The skin at this point is rendered anesthetic by producing a small wheal by the injection of a few drops of 2 per cent solution of novocain.

(f) The long cannula is then taken and the movable clasp is placed at a distance of 5 to 6 cm. from the point. In cases of swelling of the cheek, etc., the distance is somewhat greater.

(g) *It is important that the needle be inserted in the proper direction.* This direction is such that if the needle is observed from in front, it must point directly to the pupil of the eye on the same side; while if it is observed from the side, it points directly to the articular tubercle of the zygoma. If on observation from in front the needle points too far inward, it will penetrate the eustachian tube and the solution will run into the pharynx.

If one does not observe these rules it is possible that the cannula may be carried too far forward and be inserted into the jugular

foramen. In one case, on the cadaver, Hartel found that the cannula had penetrated this canal and its point was seen in the dura at the

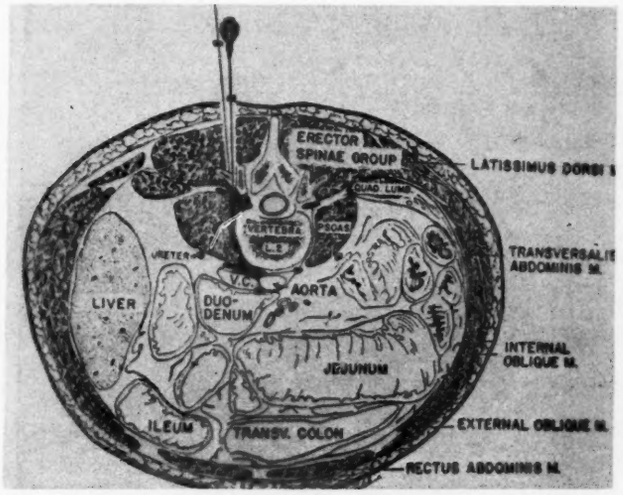

Fig. 10. Shows the method of insertion of the needle and its deflection, so that on further insertion the tip will come into contact with the sympathetic ganglion of the lumbar or thoracic ganglia. The sections of the rubber tubes as distance guides are indicated. (From White, James C. Autonomic Nervous System. P. 373, New York, 1935. MacMillan Company.)

place of entrance of the vagus and the glossopharyngeal nerves. The carotid foramen is very close to the foramen ovale, being on an average only 12.7 mm. distant, so that there is some danger in penetrating the carotid foramen. On the contrary, the jugular foramen is some distance away, being separated by an average distance of about 20 mm.

(h) The entrance into the foramen is indicated by the giving away of resistance and the presence of radiating pains in the area of distribution of the third branch. Patrick says that sometimes when the needle strikes the nerve, pain does not result, or at most, only a sensation of pins and needles is felt. When the needle has entered the foramen ovale the clasp is drawn back 1.5 cm. and the cannula is then pushed further into the foramen ovale until the pain is felt in the region supplied by the second branch, that is in the upper teeth, upper lips, gums, etc. In the last stage of the procedure no strong resistance should be felt, and if it is, the needle is in the wrong direction and must be removed and then reinserted in a different direction.

(i) After being certain that the needle is in the Gasserian ganglion the syringe is attached and ½ to 1 cc. of the solution (½ per cent novocain) is slowly injected, drop by drop. If resistance to the injections should be too great, one does not attempt by increasing the pressure to force in the solution, but rather draws out the needle to a slight degree and finds that then the solution runs in with but little resistance. If an alcohol injection is desired, we proceed under the same technic as the above, with the only exception that instead of ½ to 1½ cc. of 2 per cent novocain-suprarenal solution only a few drops are injected in order that the later procedures may be painless. Immediately following the onset of anesthesia the alcohol (½ cc. of 80 per cent) is injected directly into the ganglion. If only a temporary anesthesia, such as is necessary for operations, is needed, the alcohol injection is not made. The latter is employed only when a permanent anesthesia is desired, for instance such as is indicated in the treatment of trifacial neuralgia when a permanent anesthesia is desired. The patient must keep the reclining posture for one hour.

If the injection treatment is unsuccessful, intracranial section of the sensory root of the ganglion is the only method of control which is available.

Intercostal Neuralgia. The best measure to control the pain of intercostal neuralgia is the injection of a few cc. of

2 per cent novocaine solution or if a permanent anesthesia is desired, an injection of alcohol (95 per cent) is made into the

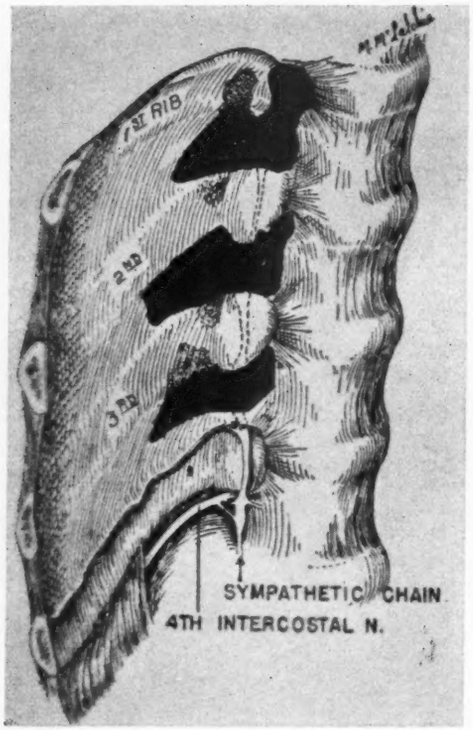

FIG. 11. Shows how spread of anesthetizing solution surrounds the sympathetic ganglia. (From White, James C. Autonomic Nervous System. P. 369. New York, 1935. MacMillan Company.)

proper intercostal space, just anterior to the angle of the associated rib which should be defined with the point of the needle. By careful exploration the lower margin of the rib is found and, beneath it where the intercostal nerve is located, the alcohol should be injected. The technic generally used is that advocated by Labat:[19]

"The intercostal nerve is separated from the pleural cavity and lungs only by the thin internal intercostal fascia and is deeply situated beneath the longitudinal muscles of the back and the external intercostal muscle. The solution must be deposited between the external intercostal muscle and the internal intercostal fascia. The patient is placed on the side opposite to the one which is to be injected, the back arched, the face and knees are brought together so as to widen the intercostal spaces. A cushion is placed under the loin to straighten the vertebral column and obtain complete muscular relaxation. Anesthetic wheals are raised at the points of greatest tenderness, 4 cm. distant from the midline. A needle [22 gauge, 8 cm. long] is inserted through the wheal and advanced in a direction perpendicular to the surface of the skin toward the posterior surface of the rib just above the intercostal space to be injected. After making contact with the rib the needle is slightly drawn back to change its direction; its hub is then inclined 45 degrees outward and upward and the needle reintroduced downward and inward toward the lower border of the rib, which is reached at different depths varying in different individuals and according to the height of the puncture in the same patient. The needle is finally advanced in the same direction 2 cm. further than the lower border of the rib. The direction of the needle is thus downward, inward and frontward across the intercostal space, and its point buried between the intercostal muscles halfway between the two ribs and about 1 cm. in front of the transverse processes. The syringe is then connected with the needle and the injection made of 5 or 6 cc. of the 1 per cent novocaine solution. Half of the anesthetic fluid is injected without moving the needle, the rest is distributed in a fan shaped manner while the needle is being withdrawn. Care should be exercised when moving the needle to and fro (a) not to change its direction, (b) not to displace it more than 2 cm. and (c) not to approach the spine closer than when the injection was first started." (Figs. 1 and 2.)

When the nerve is contacted the patient usually complains of severe pain radiating around the same side of the chest. A few cc. of 2 per cent novocaine solution or 2 cc. of alcohol are now injected. If herpes is present it may be necessary to do a paravertebral injection. Radiation from the *x*-ray in proper dosage or irradiation by radium applied over the area of the pain may give relief and should be tried in all cases of persistent pain.

Sciatic neuralgia usually requires a paravertebral injection so that the upper cords of the lumbar plexus may be injected. Sciatica is very disabling. (Fig. 3.)

Pain due to neuralgia or neuritis of any nerve, may be corrected by direct peri- or in some cases intraneural injection of

novocaine or eucaine. If a more prolonged effect is sought the anesthetizing solution novocaine or eucaine or other agents should be dissolved in oil. Local applications of heat may be of value. Neuralgias or neuritis may prove intractable to any type of treatment except direct nerve desensitization or nerve section. (Fig. 4.) In all cases, however, attempts should be made to reduce the inflammation which may be present in the sheath of the nerve by removing the cause which in some cases may be the end result of circulating toxins.

Paravertebral Injection. Should ordinary measures for the relief of peripheral pain or for pains which radiate over the chest and abdomen fail, it is then necessary to attempt the control of these pains by a paravertebral injection of the affected nerves. Injections of the selected solution, as a rule, should be frequently repeated in order to obtain a more desirable result. If the pain continues to return after repeated injections a more lasting anesthetic and nerve destructive agent, such as alcohol, should be used.

Before attempting paravertebral anesthesia the operator should obtain a thorough knowledge of the anatomy of the region. The needle is inserted at a point 3 to 3½ cm. lateral to the midline of the spine on a line with the tip of the spinous process of the next highest vertebra. The insertion is continued until the point of the needle comes into contact with the transverse process of the adjacent vertebra; this is at a depth of about 3.5 cm. The tip of the needle is then slightly elevated and the insertion is continued to a further depth of 1 to 1.5 cm. with the point directed slightly outward. The entire needle is at an angle of 20 to 30 degrees to the surface. When pain or a sensation of tingling is felt in the areas in which pain had originally been present 5 cc. to 10 cc. of 2 per cent novocaine is injected. It is necessary to keep the point of the needle far enough removed from the intervertebral canal so that the solution cannot be forced along the nerve into the epidural space and it is also necessary to avoid penetration by the needle and injection of the solution into any projection of the dural sac covering the lumbar or thoracic posterior spinal nerve roots. This method of injection is applicable to the thoracic region and the lumbar region. (Fig. 5.)

Brachial Plexus Block. Pain due to irritative changes or reactions in the brachial plexus will produce pain extending around the lower part of the neck, the back of the head and the upper part of the chest, the shoulder and into the arm, hand and fingers. Pressure by a cervical rib has been known to cause very severe neuralgic-like pains in the distribution area of the nerves arising from the brachial plexus. When pain is present in the distribution area of the nerves derived from the brachial plexus the plexus may be blocked with aqueous solution of novocaine (Tarsy and Steinbrocker[21]). It is highly effective in all intractable nonoperable disturbances of the shoulder region, also in fibrositis, myositis neuritis, bursitis and arthritis of the shoulder joint, the elbow and the wrist.

When the injection is given the patient lies on his back with his head turned away from the side to be injected and his hand is placed against the lateral surface of the thigh. The shoulder is depressed to bring the clavicle down, away from the chin as far as possible. An intradermal wheal is made at the midpoint of and slightly above the clavicle, and the novocaine solution is injected into the subcutaneous tissues in the line of the clavicle and about 3 cm. above it. The subclavian artery is now palpated and where it passes under the clavicle, at a point corresponding to the middle of the clavicle, a needle is introduced in a direction, which if prolonged, would meet the spinous process of the second thoracic vertebra. The needle is cautiously advanced until the tip comes into contact with some of the nerves forming the plexus.

Parasthesia (a sensation of tingling) or pain is felt in the area of distribution of the nerve with which the tip of the needle has

come into contact. The median is usually the first nerve with which the needle comes into contact and the radial usually is the next. In every instance as soon as tingling or a pain is felt, 10 cc. of a 2 per cent solution of novocaine is slowly injected. As the injection proceeds, the patient notices that the fingers and arm at first feel warm and then gradually become numb, and finally in ten or fifteen minutes complete anesthesia is present over the entire arm.

Spinal Root Pain. In some instances the pain may be due to a root lesion, i.e., inflammation, pressure by adjacent bone or exostoses, cord or meningeal tumor. According to Leriche[22] "a pain of root type has a characteristic topography. In some examples it may have no tangible cause, such as tabes, tumor, or Pott's disease. The neurologist has termed it radiculitis. A pain of much the same general characteristics but with a more indefinite distribution boundary may be due to changes in the thoracic or lumbar sympathetic ganglia or plexi. In such cases it may be necessary to infiltrate the dorsal or lumbar sympathetics. Usually the first injection makes the pain worse; after the second injection it disappears."

If the root pain is due to the irritation of the sensory conducting tracts in the spinal cord or if it is due to spinal meningeal lesion it can be permanently relieved only by proximal section of the spinothalamic tract in the spinal cord. If it is due to a tumor, a nucleus pulposus or a thickened subflavum ligament external to the cord the pain may be relieved by removing or correcting the lesion causing the pain. Tabes dorsalis also causes very severe and very annoying pain. It has the typical root distribution. Morphine, as a rule, only ineffectively controls it. To eliminate this pain it is necessary to stop conduction in the posterior roots. This may be done by section of the roots or by blocking of the conducting fibers, by intraspinal injection of alcohol according to the method of Dogliotti. This method requires hospitalization.

TREATMENT OF MUSCLE PAIN

Tendency of Pain to Become Less Severe. In our treatment of muscle pain, *the so-called muscular rheumatism*, it is well to remember that inflammatory pathologic reactions in the muscles frequently tend either to disappear entirely or to produce fibrous deposits or plastic exudate that becomes congealed and leads to the formation of connective tissue and adhesions. These adhesions, even though they are soft and of minimal strength, hinder motion between the fascial layers, movement between the fascial layers and the muscle bundles, and that of the muscle bundles to each other and to other anatomic structures, so that the sliding of one or all of these structures over each other is restricted and becomes painful. This condition is called myofascitis. Apparently the pain due to a myofascitis frequently is the result of chilling of the surface area of the body over the muscles which later become affected. Proper night covering should be provided and exposure of the sensitized area to drafts, cold air and chilling should be avoided. Toxic absorption from tonsils, teeth, gallbladder or intestine is a causative factor of importance and should be investigated and corrected. Toxic absorption leading to a chronic state of pain is also manifested in the neuralgic pains (neuritis—intercostal, sciatic). Chronic headache is another manifestation of the same type of pain.

In all cases in which intractable pain is due to inflammatory lesions absolute rest of the affected part must be instituted as long as the primary cause of the pain remains active. Persistence of the inflammatory process is indicated by increase in the severity of the pain on functional activity of the muscles. Chronic and noninflammatory states are improved on functional movement.

In résumé we may quote from W. J. Kerr:[23]

"*Temporary symptomatic relief* from pain may be obtained *from drugs*, salicylates,

phenacetine (10 gr.), and the barbiturates, aspirin in 5 to 15 gr. doses is also advisable. Cincophen 10 gr. twice daily may be of value, or *local heat* may be applied. This may be in the form of moist heat, radiant heat, electric pad, hot water bottles, the application of irritative plasters; or the use of a hot electric iron or flat iron moved back and forth along the spine over several thicknesses of a bath towel. Diathermia or the short wave current may also be used. Gentle massage and manipulation may be helpful. If the condition is chronic, the exercise and massage and forcible kneading undertaken should be vigorous. In some cases of cervical arthritis, stretching of the neck may be resorted to with great relief. Violent manipulations can cause fractures of the vertebrae or their processes and should not be done."

If tenderness is not present on palpation of an area of the back or other part in which pain is complained of, the pain is likely to have been referred from some other region. This diagnosis is verified if there is in addition a skin hyperesthesia which is elicited by light pressure but can be abolished by deep pressure.

BACKACHE

The aching and distress of a painful back is one of the most disturbing ills. If severe, there is no position in which ease is obtained; day or night it may be master of the patient's thought, interfere with all business and social activities and have an influence on the functions vitally necessary for physical and mental well being. Pain decreased by sleep and rest in bed, felt most severely on arising in the morning and then decreased on movement of the body is a good diagnostic indication that the lesion is a myofascitis. In this condition there is a sort of fixation of the muscle; the individual fibers do not glide by each other with normal ease. Everything seems to be stiff and, using an appropriate term, somewhat frozen, so that there is retardation of the gliding mechanism of the muscles and other components of the area on each other.

Before attempting any physical corrective measures, the patient should be stripped and carefully examined. The existence of a curvature of the spine, the presence of lordosis, kyphosis, scoliosis, etc., with the degree of vetebral fixation should be carefully noted. If the alignment of the vertebra is false, it should be corrected. It is surprising to find that a lift of one-fourth to three-fourths of an inch to the shoe of the foot, on the shortened side, will relieve many a pain due to a shortened limb. The posture assumed by the patient may be the cause of vertebral and muscular strain; if so, it should be corrected. Weak muscles are to be strengthened by appropriate exercises. If this is unsuccessful, a protective support is to be used.

If pain is also referred down the leg particularly in the sciatic area, especially if there is a history of injury which affected the back, we should eliminate the possibility of an injured intervertebral disc or a nucleus pulposus.

Indications for injections of analgesic producing substances into painful muscular or ligamentous areas are given, when, after thorough physical examination and study, visceral disease has been eliminated as the source of pain. Corrective injections may be used in traumatic, rheumatoid, or degenerative processes of joints, periarticular tissues, nerves, bursae and muscles.[24] Before injections are made into the muscles of the back, referred pain from the viscera should be excluded. In some instances a *pendulous abdomen* will cause back pain by its excessive drag and distortion of the vertebral column. A proper fitting abdominal support and dietary correction of the overweight will frequently relieve the pain.

If intramuscular injection is necessary, it is made directly into the painful area. Aqueous solutions of an anesthetic agent cause evanescent effects which pass away in a day or two. A much longer period of relief follows the injection of an oily anesthetic solution.* Injection of sarapin, a

* Injections should be made with great caution in diabetic patients and under no circumstances should be made in patients with diabetes not under control.

substance found in the pitcher plant, may be used. Thiodocaine, a preparation introduced by the Midy Laboratories, Paris, also has been used. Quinocaine also has given good results. Before the pain returns to its previous severity the area should be again injected and this should be repeated for as many injections as may be necessary. In some instances it may require an injection every two or three days for several weeks; in other individuals one or two injections may give permanent relief. At the least return of the pain the injection should be repeated.

Before giving regional and local injections there should be a routine preliminary sedation with phenobarbital (1½ gr. tablet administered orally twenty to thirty minutes before treatment).

Technic. The site of maximum tenderness is determined by palpation or is best defined by the patient who presses in with his index finger, (scattered areas of marked tenderness may be present). These points which are the ones selected for injection are marked with a skin pencil. These sites should be sterilized with alcohol, tincture of iodine, tincture of methiolate or some other antiseptic.[25] Small intrasubcutaneous wheals are made in the marked areas by injecting a 2 per cent novocaine solution. A needle, 22 to 24 gauge and 10 cm. long is now inserted deep into the muscular tissues (generally to a distance of 3 to 5 cm.) and 5 to 20 cc. of aqueous solution, or 1 to 5 cc. of oil solution of the selected anesthetic agent is injected directly into the site of the pain and tenderness. If the needle encounters an extremely painful area, it is slightly withdrawn and the solution is slowly injected. If a fascial or muscular resistance plane is encountered about 5 cc. of the aqueous solution is injected, or about 2 cc. of the solution in oil. The needle is then inserted deeper until the tip comes into contact with bone. It is then slightly withdrawn and more solution is injected. If the needle is not slightly withdrawn, the solution may be injected into or under the periosteum and severe pain may follow the separation of the periosteum from the bone. The minimum of force should always be used. During the injection, repeated attempts are made by drawing back the piston to aspirate blood or fluid, in order to determine if the point of the needle has penetrated a blood vessel or perhaps has entered the spinal subdural (arachnoid) space. If painful, sharply circumscribed, subcutaneous or intramuscular nodules are palpable, they are penetrated with the needle and a few cc. of the solution are injected into the center of each nodule; the treatment is completed with radiating injections of 3 to 5 cc. of the aqueous or oil solution about and beyond the nodule. If a nodule remains persistently and exquisitely tender, 0.5 cc. of 95 per cent alcohol is injected into the nodule and 5 cc. aqueous solution of novocaine about the site of pain.

The pain of extensive fibrotic involvement of fascia or muscles, particularly in the gluteal and low back regions, can be relieved by injections of 10 cc. of 2 per cent procaine followed by 25 to 100 cc. of normal saline. After injection is completed the needle is quickly withdrawn and slight pressure is made over the site of the injection. Tenderness and crepitation frequently disappear after one or two such treatments.[26]

If the anesthetizing fluid is injected too superficially, bulging of the injected area will follow and may needlessly alarm the patient. Previous warning that such a swelling may occur and be painful should be given to the patient. It is also common for pain to persist several hours after the injection. These pains, according to Steinbrocker[26] are usually due to excessive

They also should not be made in areas adjacent to infections, in severely debilitated individuals, in those who are critically ill or in those sensitive to the anesthetizing drug. Injection treatment should not be used when acute inflammatory reactions are present, or if surgical measures are preferable. In patients who are bad risks this method of treatment should not be used, as it has been known to produce shock resulting in death.

trauma in the passage and manipulation of the needle, or may be due to backflow of the medication, infiltrating and irritating the superficial tissues. The after-pains are relieved by heat applied locally with an electric pad, hot water bottle or warm baths followed by gentle massage.

To facilitate the separation of muscle bundles and fascial planes, forcible massage, percussion of the affected area and vibratory massage should be given immediately after the injection. Direct application of heat by hot packs, hot baths, or by diathermia short wave, infra red ray or the incandescent lamp should also follow.

In our treatment of myofascitis we should not be deceived in regard to the origin of the crepitation which is both heard and is felt on movement of the affected part, especially if the cracking sound and sensation is near a joint. This crepitation is seldom caused by disturbance in the articulation, such as would be produced by the rubbing between two opposing eroded joint surfaces, but is the result of friction from the over-riding rough surfaces of muscle, ligaments and tendons. If the condition is acute, one or two injections of an anesthetizing solution directly into the crepitating areas may suffice to relieve both pain and crepitation. If the condition is chronic, repeated and long continued treatment may finally lead to success. As Maliwa states, "we should not be discouraged by the necessity for prolonged duration of the treatment which for a long time may be without effect."[27]

After the injection the muscles should be put to use, and active exercise and calisthenic movements should be undertaken. Abnormal postures and positions should be avoided. Occupational habits leading to muscle strain or to overexertion should be corrected. Improvement in the well-being of the patient will follow rest and sleep. For this reason, temporary use of narcotics may be necessary; on the relief of pain the patient's outlook is brightened, his morale is stimulated and the use of pain controlling drugs is eliminated. The patient is happy and cooperative for the intramuscular injection may give the first appreciable relief that has been obtained in an extended period of discomfort and disability.

The beneficial effect of analgesic solutions injected into a painful area probably is due in part to direct separation of the components of the affected tissues from each other by the volume of the injected solution; and indirectly by increased nutrition of these tissues and the improved local elimination of toxic and deleterious substances due to the hyperemia, which results from the vasodilation arising from the blocking of the sympathetic nerve supply to the blood vessels by the anesthetizing agent. It is also probable that a form of regional shock therapy occurs. This adds a further congestive factor to the hyperemia. Large quantities of fluid injected into the muscle and fascial tissues also facilitate the desired effect. The presence of free fluid facilitates the movement of the muscle tissue bundles and fascial layers on each other, especially so if the adjacent approximating surfaces have become roughened or dessicated. Drying out and roughening of the tissues may be presupposed from the crepitation which is present on movement. On the injection of novocaine, eucaine or other substances dissolved in water or in oil, the crepitation ceases but again may be felt and heard when the fluid is absorbed.

It is also to be inferred that solutions (anesthetic in character) injected into the muscle and the fascia will separate adhering muscle bundles and fascial layers, and render insensitive the fine terminals of the sensory nerves which are irritated by the abnormal pathologic factors which are present. For the maximum effect, complete infiltration of the involved tissues should be sought.

ARTHRALGIAS

In our review of intractable persistent peripheral pain we must consider the arthralgias (joint pains). At times articular pain may be so severe and persistent that

life becomes almost unendurable. Examination of the affected joint may not reveal any lesion of sufficient magnitude to be rated as the cause of such disturbing pain. In some instances rheumatoid or degenerative lesions may be present in or around the joint, or the joint ligaments, peri-articular fascia or bursa may be involved; but these usually are found to be old lesions and can hardly be associated with pain of recent origin of which the patient complains. In many instances the joint pain follows trauma such as a slight twist, or strain upon the joint.

In some cases crepitation or grating may have been present in the joint for a long time, but was not associated with pain, until some unusual movement or exposure to cold and dampness apparently was followed by further joint disturbance and pain.

In some instances no manifest lesion can be demonstrated and the certainty of the presence of such an anatomic lesion may be questioned. The actuality of the pain, however, cannot be doubted if the usual expressions and reactions indicating pain are to be considered reliable. After peri-articular injections, the pain ceases and may not return, although the lesion originating the pain must still be present; for it is fantastic to suppose that peri-articular injections can immediately correct the pathology originating the pain.

Peri-articular Injection of Articulations, Especially the Sacroiliac, Shoulder, Hip and Knee. These articulations are often the site of severe pain. The discomfort arises from irritation of the nerve fibers supplying strained, ruptured or infiltrated peri-articular tissues, tendons and ligaments. These tissues are particularly involved at their insertions and attachments. All tender areas should be injected and the solution should be spread out in a fan-shaped manner around the joint. If the solution enters the joint it may cause some pain and temporary swelling of the joint. This disappears in a few days. Direct injections of the joint may be made if the pain is due to irritation in the joint.

Sacroiliac Injection. At times the pain in the back is low down in the lumbar area and involves the sacroiliac area. In such cases the patient when requested to indicate the painful and tender areas, will frequently place his hand over the upper sacral region and the lateral iliac crest. Pressure over the sacroiliac joint usually is painful.

NONOPERATIVE PROCEDURES FOR THE RELIEF OF LUMBOSCIATICA

W. M. Steel[28] states, "The pain of chronic lumbosciatica is transmitted down the leg through the lumbosacral and coccygeal plexuses, particularly along the great sciatic and gluteal nerve distributions. The pain is intermittent; it is aggravated by sudden body twists, lifting, exposure to wet and cold or toxic focus. The majority of cases are in this class and are apt to be relieved by minor surgical procedures."

Plan of Treatment

1. Eliminate possible etiologic factors
   - (a) Toxic foci or sources of referred pain
   - (b) Correct faulty posture
   - (c) Correct flat feet
2. Measures to absorb local fibrosis and free adhesions
   - (a) Heat and massage
   - (b) Passive motions
   - (c) Nerve stretching
     - (1) Postural and open methods
     - (2) Endoneural sciatic injection
     - (3) Epidural intrasacral injection

According to Steel, if the above measures are unsuccessful or too tedious, pain relieving injections of appropriate solutions may be used. Injection should be made into the painful areas and should be extended down to the underlying bone. At least 20 cc. of the anesthetizing solution should be injected over each sacroiliac articulation. Afterward, forcible rotation and extension of the pelvis is to be carried

out. If the pain radiates down the outer side of the leg and there is an associated involvement of the iliotibial band and the piriformis and adductor muscles, the solution should be injected into the tender spots over the involved areas and should be diffused in a fan-shaped direction through the involved muscular areas. Twenty cc. or more of a 2 per cent solution, 5 cc. of procaine or novocaine in oil or 10 cc. of thiodocaine solution can be used. The injection should be followed by active and forcible massage, even pummeling of the muscle may be effective. Forcible but not abrupt and jerky hyperextension of the back, flexion, adduction and abduction of the thigh should conclude the treatment. After-treatment should be rest with the application of heat, diathermia or the short wave. (Fig. 6.)

The same procedures should be repeated every few days until the pain ceases permanently. In the intervals between injections, heat applications, exercise, and massage should be continued.

SHOULDER PAIN

It is not unusual for the practitioner of medicine to be confronted by a patient who complains of severe pain in the shoulder, radiating down the arm, with areas of pain running transversely across the lower third of the upper arm, in the elbow region and on the dorsum of the hand. These areas, especially those in the upper arm, are painful to pressure. Pressure on an area below and external to the acromion process is also painful and may cause pain to radiate down the upper arm. A peculiarity of these pains is that it is very difficult for the patient to locate them exactly in any one particular and definitely delimited area. The patient also is unable to raise his hand above his head, he cannot comb his hair with the affected hand nor, if he is a man, can be put his hand into the hip pocket on the affected side.

If the above pain references are due to involvement of nerves, it seems remarkable that all pain in the shoulder and arm may be relieved by injection with novocaine or other desensitizing solutions into the area where localized tenderness is most marked which in many instances is inferior and lateral to the acromion process.

The explanation of the bizarre and unconventional relationship of the pain areas to each other is that there must be some indirect reference of causative stimuli, probably through the medium of sympathetic nerve distribution. It is also remarkable that forcible manipulation, by which the myofascial adhesions are broken, will in many instances give immediate relief of pain to such a degree that the patient can raise his hand above his head without pain. Previously he could not raise the affected arm higher than at a right angle with the body.

It is true that the pain may return but additional injections can be given and repeated manipulation may be used. After correction, massage of the shoulder and arm must be given and heat, moist or dry, must be consistently applied. The arm should be used. It must be protected from chill and drafts.

If the pain in the lower part of the arm or in the forearm is not relieved by the higher arm injections, other injections should be made into the painful areas in the lower arm and in the forearm. If a contracting muscle band or painful nodule is located, the anesthetizing solution is injected directly into the nodule or into the contracted muscle bundle and at its fascial insertions into the bone.

A significant indication of noninvolvement of the joint is that after the muscle injections free movement of the bones forming the joint is possible without the production of pain.

HIP PAIN

When a man or woman comes limping into the doctor's office, he or she will frequently claim that the limping is due to pain which they have in the hip. They may give no definite causative history

except that at one time they had a mis-step and the pain followed. It may have been present for months. Drugs and various applications to the skin have relieved it but it always returns and is then as bad if not worse than it was previously. Examination shows perhaps some atrophy of the leg muscles on the affected side but not more than would result from lack of use. Attempts to elevate the leg to a straight position perpendicular to the table, when the patient is lying flat on his back, causes great pain referred down the leg. Yet, there is no very severe pain when pressure is made over the course of the sciatic nerve. In these patients tenderness is marked in an area posterior to the head of the femur at the point of insertion of the fascia of the tensor vagina femoris. In this area, 20 cc. of anesthetizing solution is injected.

It is frequently a necessity that the narcotizing solution be injected into the area of the sciatic nerve deep in the buttocks. (Fig. 7.)

Injection should also be given into any of the nine points where it will be most effective. In every instance, injection should be made into the painful areas of the muscles where they are attached to the bone. Injection into the upper cord of the lumbosacral plexus should be made through the triangular space between the crest of the ilium and the lower lumbar vertebra. Injection should also be made in the tender areas over the sacroiliac articulation. In each of these areas, 5 to 10 cc. or more of the anesthetizing solution should be injected. If the areas are very numerous, they should be injected in two or more sittings.

Knee. The seven point injection scheme of Forestier[29] for the knee will require two or three sessions. If aqueous novocaine solution should enter the joint a slight reaction will usually follow. If the oily solution was used, a mild, acute, chemical arthritis with swelling of the joint and pain may ensue. The effusion into the joint appears in six to twelve hours and lasts for a few days. (Fig. 8.)

Foot. Flat feet cause pain which is referred to the inner side of the knee, to the calf muscles, and along the insertion of the articular ligaments. Injections should be made into the painful areas of the foot in flat foot, broken transverse arch, in the areas of pain in hallux valgus (bunions), in exostoses (spurs) and in Morton's metatarsalgia. Of course in these conditions it is necessary to correct the gross anatomic defects and abnormalities. The injection of analgesic solutions is of great value when quick relief is urgent. That proper orthopedic measures be used in association with corrective measures for relief of pain is indicated in the case of a patient who after removal of spurs on the os calcis had pain in the operated area on standing. This was relieved by building up and fitting a proper support for the arch of the foot.

SYMPATHETIC NERVOUS SYSTEM

Pain Due to Involvement of the Sympathetic Nervous System. In patients in whom efforts to relieve the pain by treatment directed at the somatic nervous system are unavailing, attention should be directed to the sympathetic nervous system. The proportionate involvement or activity of the somatic and of the sympathetic nervous system should, if possible, be determined. It is only recently that the medical profession has been cognizant of the great part played by the sympathetic nervous system in the induction and the continued manifestation of pain. It is seldom recognized that many of the severe pains following an injury of, or involvement of the somatic nerves of the periphery are of sympathetic origin. These pains are extremely difficult to control, and are not amenable to treatment except by desensitization of the appropriate sympathetic ganglia (by localized injection of narcotizing drugs) or by sectioning or resection of the sympathetic cords. Late in the disease no type of curative procedure may prove effective; for this reason, corrective measures should be instituted early in the condition.

Characteristic of these pains is the indefiniteness of their localization, the variability of their intensity and the inconstancy of their manifestation; at times they are persistent and again they come and go. At all times the patient is miserable and depressed. This is consonant with the fact that the pain, which has its origin in the *sympathetic nervous system*, seems to affect the general well-being of the individual more than do pains of somatic origin. A reason for this may be that the sympathetic nervous system is closely connected with the vital processes and functions of the body and is a co-regulator of the visceral activities, so that disturbance in one of its divisions may involve the other divisions and have a far reaching effect.

It is also true that pain of sympathetic origin is of particular importance because many of the viscera give rise to pain sensation transmitted through the sympathetic nerve fibers; the most important of these are the pains referred from the kidney, liver, uterus and adnexa, heart and lungs. Since there is no pain sensation located directly in the viscera, abnormal impressions are reflected into peripheral somatic distribution areas where they are felt as pain.

Relief of the pain reflected from the internal viscera may be obtained by injection of the appropriate sympathetic ganglion or ganglia with narcotizing substances or with alcohol. The pain of angina pectoris may be relieved by injection of desensitizing substances or of alcohol in the upper four thoracic ganglia on the left side, pain derived from the kidney by injection of the lumbar ganglia; genital pain can also be controlled by injection of the lumbosacral sympathetic plexi.

In studying the relation of pains of somatic and of sympathetic origin, R. Leriche[22] noted a remarkable integration between the somatic and the sympathetic nervous system. He found that, "If in the case of a pain with a well defined topography—a pain of unchanging character, and which has no definite irradiations, a pain, that is to say, of the cerebro-spinal type—the corresponding sympathetic ganglion is infiltrated, the pain disappears. The anesthetizing of the one system abolishes the pain which affects the other."

If we consider the extent and volume of the sympathetic nervous system it is easy to understand how extensive and severe disturbances may follow any maladjustments of its functions or insults to its integrity. It is reasonable to suppose that changes in its structural components, or environmental relationships may occur and give rise to severe disturbances, some of which are manifested by pain. As the activities and influences of this system are becoming more clearly defined we are increasingly amazed at the imputations which they present.

Many of the adverse complaints due to involvement of the sympathetic nervous system may be corrected by desensitization, or destruction of the sympathetic transmission pathways by injection of narcotizing solutions into and around the ganglia and sympathetic plexi. This procedure is not as complex nor as difficult as it seems, because the sympathetic plexi and cords lie anterior and lateral to the bodies of the vertebra and can be reached comparatively easy by a properly introduced needle through which the narcotizing substance is injected and infiltrates the adjacent tissues.

Technic of Injection: Cervical and Upper Thoracic Sympathetic Ganglia Injection. Have patient lie on the side opposite to that which is to be injected. The shoulders are at the edge of the table, the spine is flexed and the knees are drawn up; the head is supported on pillows so that the spine is straight. Hands are uncovered so that they can be observed and the effect of injection noted. If alcohol is to be injected, it is preferable to do the injection in the patient's bed. Complete immobility for one hour is stressed so that the alcohol does not become diffused by movement after the injection, with involvement of adjacent nerves and tissues. (Fig. 9.)

Technic. The prominence of the dorsal spine of the seventh cervical vertebra marks the level of the transverse process and the angle of the first rib, and this relationship holds true for each succeeding spinous process. The point of insertion of the needle is indicated by a mark 3 to 4 cm. from the middle of the back on a line, level with the spinous process of the selected vertebra. This mark is made by tincture of iodine followed by acriflavinae; both are applied by fine cotton applicators.[30] A fine gauge (22) needle, 8 to 10 cm. long is inserted at the point indicated, perpendicular to the skin, to a depth of about 3 to 5 cm., until it comes into contact with bony resistance (the transverse process of the vertebra or the rib). The depth marker, a small piece of Dakin's tubing which is impaled on the needle, is now adjusted to a distance of 3 cm. from the skin. The needle is inclined slightly in a caudal direction and after the edge of the lower border of the rib is located, it is inserted to a further depth of about 3 cm. at an angle of 20 degrees to the midline. Usually at this depth the resistance of the lateral aspect of the body of the vertebra is felt. It is gradually edged along this resistance until a depth of 3 cm. is reached. The needle is now attached to the syringe. Two to 3 cc. of a 2 per cent novocaine-adrenalin solution or a similar amount of thiodocaine or alcohol is injected. The solution bathes the sympathetic trunk, the sympathetic plexus, and the spinal nerves which lie in the lateral vertebral groove. If characteristic signs of anesthesia do not follow in a few minutes, 3 cc. of a 1 per cent solution is injected in the same areas.

If the tip of the needle should enter an intervertebral prolongation of the dural sac (cerebrospinal fluid exudes from the needle), or should it penetrate the pleural cavity (cough occurs) or if it enters a blood vessel (blood would drop from the needle). Aspiration should be attempted in every instance before the solution is injected.

When the upper four thoracic ganglia are injected and the nerve blocking is effective, skin anesthesia develops in the inner side of the arm, the axilla and the area of the third and fourth ribs, the hand, the arm and the same side of the head and face become hot and dry. A Horner's syndrome is manifested. (Fig. 10.)

If permanence of anesthesia is sought 5 cc. of 95 per cent alcohol is injected after the primary 2 cc. of 2 per cent novocaine-adrenalin has been injected into each lateral vertebral sulcus.

If severe pain occurs at any stage, the injection is stopped for a few minutes until the patient recovers his equanimity. The patient is kept quiet for at least an hour after the injection.

The anesthesia of the skin to visceral referred pain is permanent but the skin anesthesia of painful areas due to involvement of the intercostal nerves is not permanent.

Lumbar Sympathetic Ganglia Injection. The patient lies on the abdomen. The dorsal spines are identified, the spine of the fourth lumbar vertebra is at the level of a line drawn between the crest of the two ilii. The transverse processes of each vertebra lie directly lateral to each spinous process.

Technic. A needle (22 gauge) 8 to 10 cm. long is inserted 3 cm. lateral to the upper margin of the spinous process of the appropriate vertebra. It is pushed perpendicular to skin to a depth of 4 to 5 cm. when it usually encounters the transverse process. When it does so, the rubber marker is drawn back 3 cm. The point of the needle is now moved upward or downward until it passes the obstructing transverse process. The needle is deflected to an angle of about 20 degrees with the midline and inserted until the lateral body of the vertebra is encountered. Gradually, the point of the needle is cautiously advanced along the vertebra until the progress is unopposed. Should parasthesia occur at any stage of this procedure, then it indicates that the lumbar nerves have been contacted and the direction of the needle is then slightly changed. The tip of the

needle is now in the space in which the sympathetic nerve trunks are found. If no fluid (blood or cerebrospinal fluid) drips from the needle, the syringe is attached and 2 cc. of 2 per cent novocaine is injected. (Fig. 11.)

If the injection is successful, there is immediate warning and drying of the corresponding foot, anesthesia of the skin of the back, the side of the buttocks and the peripheral distribution skin areas of the genitocrural, the anterior femoral and the lateral femoral cutaneous nerves.

When the above occurs, more 1 per cent novocaine-adrenalin solution or 3 to 5 cc. of 95 per cent alcohol may be injected if a permanent paralysis is contemplated.

Injections may also be made at the levels of the second, third and fourth lumbar vertebrae. The position of the fifth lumbar vertebra precludes injection lateral to its body.

Paravertebral lumbar injection is indicated in painful lower extremities when the pain is due to vasomotor neuroses. Caution should be exercised in ischemic painful conditions as in pain caused by diabetic gangrene in which the pain may be due to vasomotor spasm or organic occlusion, also in endarteritis, Raynauds intermittent claudication, and atypical neuralgias in which no definite nerve distribution area is involved. The so-called causalgias may be relieved by paravertebral injections. Referred visceral pain may also be relieved in many instances by paravertebral sympathetic nerve injection.

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MANAGEMENT OF LOCAL ANESTHESIA, PARTICULARLY FOR THE DIABETIC PATIENT*

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DIABETIC patients are subject to the same conditions which effect those without diabetes and are particularly prone to infection and acidosis. They are also quite liable to arteriosclerosis with its attendant cardiac and renal damage. Infection renders diabetes more severe and intractable, and therefore requires more radical treatment than is necessary for most other patients. General anesthesia has a tendency to produce or increase acidosis. If real anesthesia can be obtained by means which will not disturb the diabetic patient's delicate metabolism, a great advantage is obtained. Thus, for major surgery of the abdomen, pelvis and lower extremities, or for perineal surgery, spinal anesthesia is usually easy and safe if one understands its limitations. If such procedures are imperative on diabetic patients with marked cardiovascular disease, field block and splanchnic nerve block are preferable for the abdomen and a combination of caudal and sacral block for the perineum.

Local anesthesia is a great boon to both the patient and physician in minimizing necessary procedures from the patient's point of view, and by increasing the comfort and thereby confidence with which patients submit to such procedures. The use of a local anesthesia is avoided by most physicians because of the time required and the frequent failure to produce good anesthesia. Failures occur because physicians overlook certain requirements such as the necessity for getting sufficient solution in the right places and allowing time enough for adequate anesthesia to ensue. These items are not difficult but allow of little compromise. However, they cause many men to dodge the issue of an accurate knowledge of the nerve pattern of the area and the allowance of sufficient time from a busy practice. Actually very little time is required after one is accustomed to the use of local anesthesia, and if these procedures are done in the office, injections can be made and some other duty performed while anesthesia is occurring, so that when one returns to the patient in question, everything is ready to start and little time is wasted.

In general, the advantages of local anesthesia are: (1) less danger than almost any form of general anesthesia; (2) less reaction to, and quicker recovery from the necessary manipulation; (3) it minimizes the procedure; (4) in large operations there is definitely less shock per unit of time and trauma, and (5) specifically, there is much less disturbance of a diabetic patient's equilibrium and chemical balance. The instruments required are simple, and the accompanying photograph (Fig. 1) reveals a good layout for such practice.

It is best in all patients, and particularly important in those with diabetes, to obtain anesthesia with the least trauma, without over distention of tissue or the use of excessive fixative in the solution, either of which may produce avascularity with its attendant ills. It is important to avoid injection in the proximity of infection, and it is preferable to use field block at an adequate distance from this area. These objects are accomplished best with the 1 per cent solution of novocain containing 1 m. of pituitrin to each ounce, or 1 cc. to each 500 cc. of solution. Pituitrin is preferable to adrenalin because of its lessened constricting effect upon the coronary arteries which becomes very important in older patients or those with cardiac disease. Novocain solution

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without some form of fixative to prevent its rapid absorption produces a very brief anesthesia often amounting to fifteen or twenty minutes. Occasionally, this is adequate time, but if one waits ten minutes to allow the anesthesia to occur, there are many procedures which cannot be completed in the remaining five or ten minutes. In addition, a more prolonged effect decreases postoperative pain. The rapid absorption of novocain solution without some fixative or vasoconstrictor is much more likely to produce toxic manifestations. Conversely, large quantities, 500 to 600 cc., with fixative included, have frequently been used with only occasional mild toxic response and this usually was due to intravascular injection. Vessels should be carefully avoided. Aspiration with each new position of the needle will indicate the entrance of the point into a vessel by the withdrawal of blood into the syringe.

It is wise (1) to make a slow, gentle approach using very fine needles, at least for the original injection, and progress from anesthetized areas by subcutaneous advance of the needle to produce additional wheals from beneath the skin by means of which painless administration can be made; (2) to inject slowly, since rapid injection of itself is painful and (3) to use adequate amounts for the areas to be blocked. Consideration of all of these factors is necessary for an almost painless production of anesthesia which patients greatly appreciate.

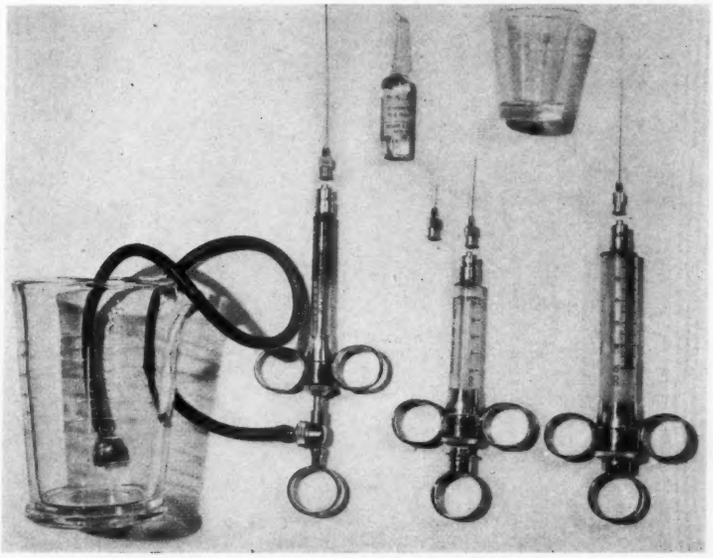

Fig. 1. Three and 10 cc. Luer-Lok ring-handled syringes and 3 cc. pump syringe and infiltrations with containers of various sizes for solution.

REGIONAL BLOCK

It is important to consider the nerve pattern of special regions where minor surgery is frequently indicated.

Toes. Ingrown toenails, infections and the removal of warts or corns can be done painlessly by the injection of a collar of novocain at the base of the toe to interrupt the two plantar and two dorsal digital nerves which lie in the subcutaneous fat. This can be done with 5 to 10 cc. of solution and a 25 20 27 gauge one inch needle using one original and two subsidiary wheals to completely surround the base. (Fig. 2.)

Foot. If infection of the toe is fairly extensive, and particularly if it extends up on the dorsum, the use of ankle block is preferable to injection in the area proximal to the infection. This location of nerve interruption can be used for repair of lacerations or tendons, toe amputations, removal of ganglia, drainage of osteomyelitis, etc. Figures 2 and 3 will reveal that an injection immediately behind the

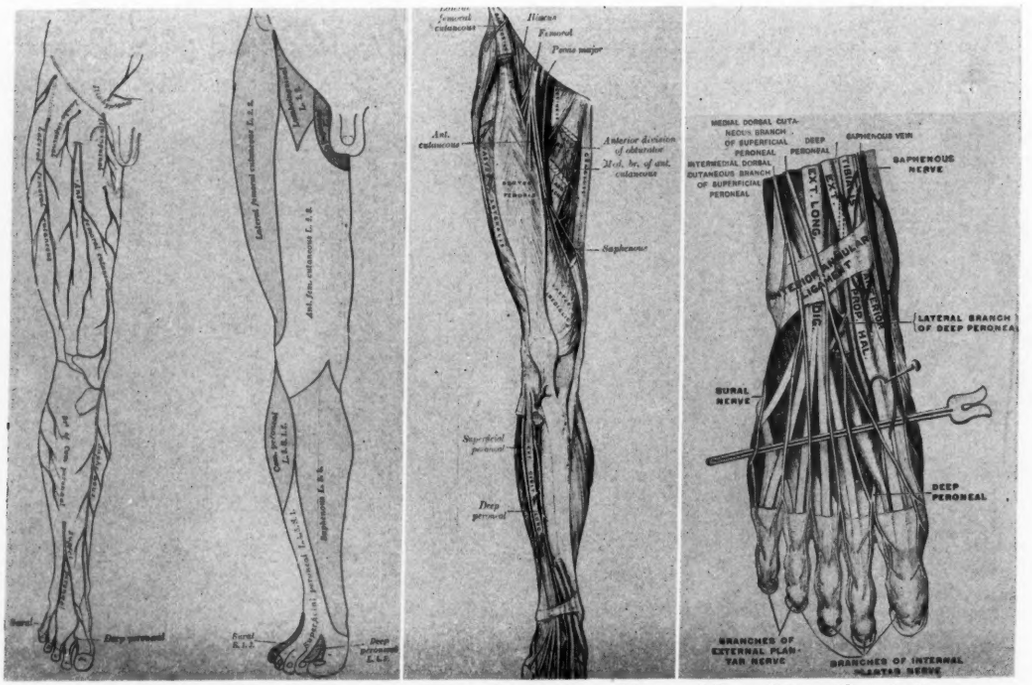

FIG. 2. Superficial and deep innervation of anterior surface of leg and foot. (From Gray's Anatomy, 23d Ed. Edited by Warren Lewis. Philadelphia, 1936. Lea & Febiger.)

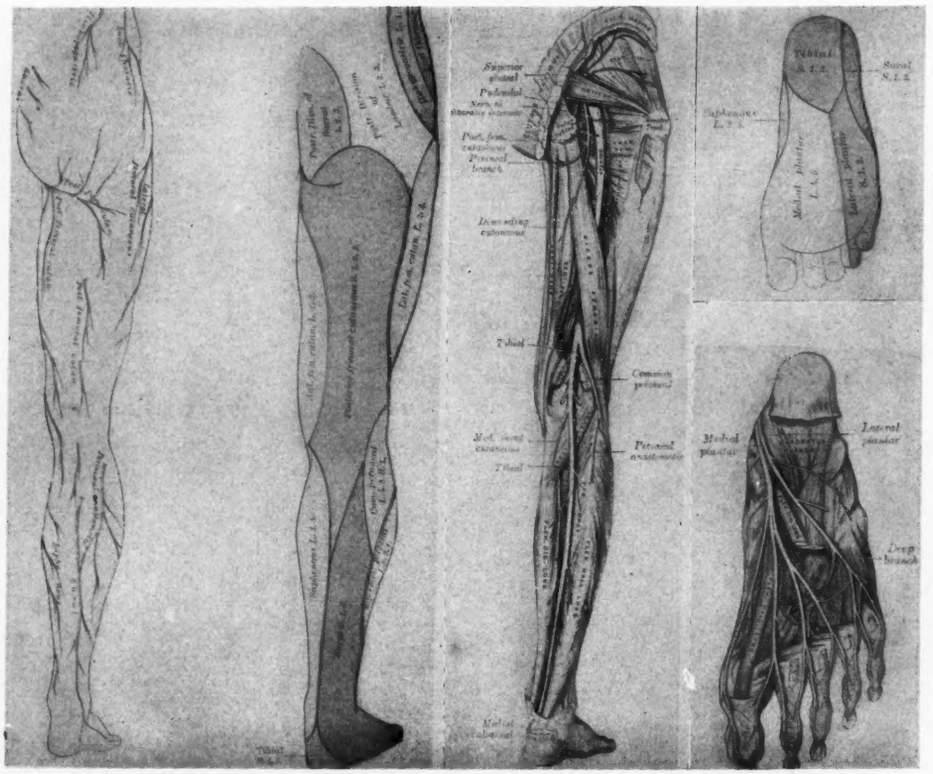

FIG. 3. Superficial and deep innervation of posterior surface of leg and foot. (From Gray's Anatomy, 23d Ed. Edited by Warren Lewis. Philadelphia, 1936. Lea & Febiger.)

internal malleolus and just medial to the dorsalis pedis artery at the cruciate ligament will block the posterior tibial and the higher up, (Figs. 2 and 3) will produce anesthesia of the foot and calf. Fifty to 100 cc. of solution are adequate.

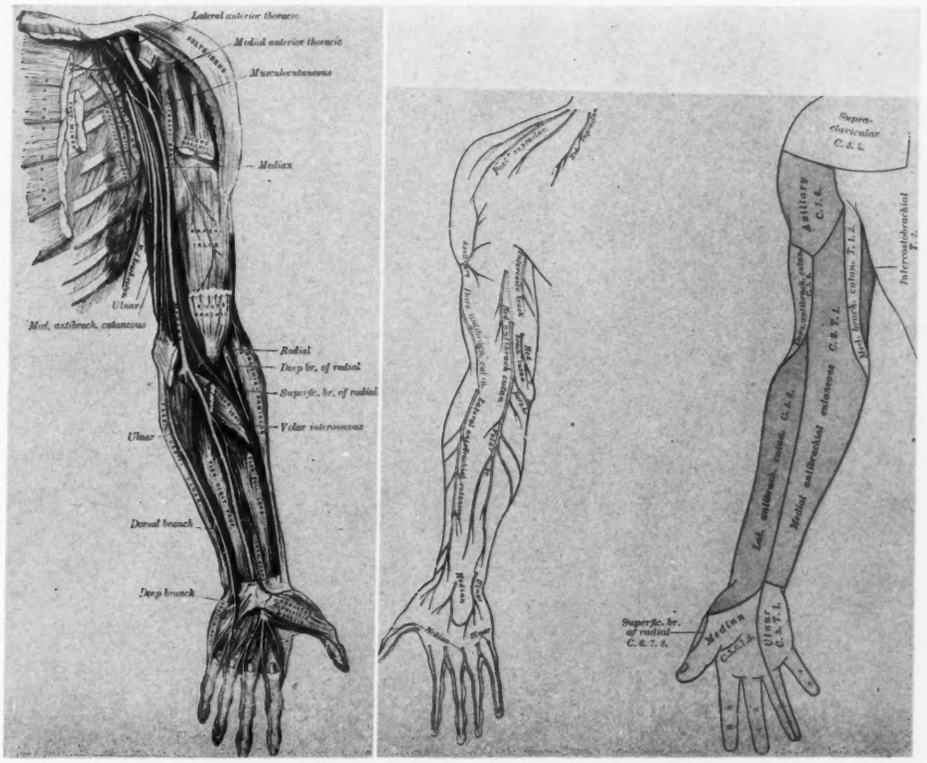

Fig. 4. Superficial and deep innervation of anterior surface of arm and hand. (From Gray's Anatomy, 23d Ed. Edited by Warren Lewis. Philadelphia, 1936. Lea & Febiger.)

deep peroneal nerves, respectively. These combined with a collar injection to interrupt the branches of the superficial peroneal on the anterolateral surface and of the saphenous in relation to the saphenous vein, will produce good anesthesia of the entire anterior half of the foot. Approximately 25 to 35 cc. of novocain will suffice.

Calf. If it is necessary to have anesthesia higher than this, as for amputation at ankle or midcalf, varicose vein ligation, etc., injection of the common peroneal as it passes around the neck of the fibula, of the saphenous as it passes from posterior to anterior on the medial side of the knee just below the head of the tibia, and of the posterior tibial in the popliteal space between the heads of the gastrocnemius and superficial to the popliteal artery where it crosses from lateral to medial, combined with a superficial collar injection to interrupt branches which have been given off

Thigh. Operation on the thigh, including even midthigh amputation can be done by injection of the sciatic nerve as it passes midway between the tuberosity of the ischium and greater trochanter of the femur, injection of the femoral nerve where it passes under the inguinal ligament just lateral to the palpable femoral artery, and of a circular barrier, both superficial and deep, of the thigh a few centimeters below these points to interrupt branches of the obturator, lateral femoral cutaneous and posterior femoral cutaneous nerves. This requires 100 to 150 cc. of novocain.

Fingers. Similarly, one can operate upon or manipulate the fingers by a basal block of a superficial collar similar to that advised for the toe. (Fig. 4.) Lesions likely to require minor surgery are: bone felons, paronychia, ganglia, lacerations, etc.

Wrist. For more extensive infections such as tenosynovitis, midpalmar and

thenar space collections, tendon suture, finger amputation, etc., good anesthesia of the entire hand can be obtained by a wrist block using 30 to 60 cc. of novocain. Injections are made of the radial nerve just lateral to the radial artery, the median just to the ulnar side of the palmaris longus tendon between it and the flexor carpi radialis, and of the ulnar just medial to the associated artery. (Figs. 4 and 5.) This is finished off by superficial collar injection to interrupt branches given off above the point of injection of the nerve trunks. Forty to 60 cc. are sufficient.

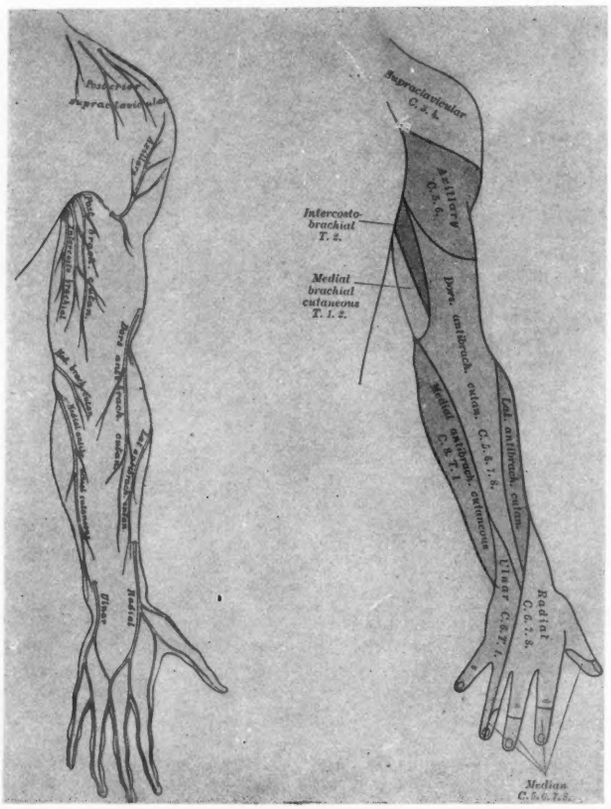
Supraclavicular C. 3. 4.
Axillary C. 5. 6.
Intercosto-brachial T. 2.
Medial brachial cutaneous T. 1. 2.
Post. antibrach. cutan. C. 5. 6. 7. 8.
Lat. antibrach. cutan.
Medial antibrach. cutaneous C. 8. T. 1.
Ulnar C. 8. T. 1.
Radial C. 6. 7. 8.
Median C. 5. 6. 7. 8.
Radial
Ulnar

FIG. 5. Superficial innervation of posterior surface of arm and hand. (From Gray's Anatomy, 23d Ed. Edited by Warren Lewis. Philadelphia, 1936. Lea & Febiger.)

Forearm. Operation on the forearm and hand can be conducted under elbow block (Figs. 4 and 5) interrupting the ulnar nerve as it passes posterior to the medial epicondyle, the median as it passes to the medial side of the brachial artery and the biceps tendon, and the radial as it emerges under the lateral side of the biceps tendon with again a superficial collar injection to block superficial branches originating proximally. From 50 to 100 cc. of solution are required. Thus, closed or open reduction of fractures, drainage of extensive tendon infections which have progressed into the radial or ulnar bursa, nerve or tendon suture, tumors, amputation, etc., can be handled.

Brachial Plexus. This block is practically the most unsatisfactory of all the regional group and has been generally discarded because of its difficulty of induction. However, operations of a superficial character can be done under local infiltration of the area provided infection is not present.

Cervical Plexus. Figure 6 shows the ease with which the superficial branches of the cervical plexus can be blocked by injection along the posterior border of the sternocleidomastoid muscle half way between the mastoid process and the sternoclavicular junction. This is adequate for operations

on the skin or in the subcutaneous fat, and for the biopsy or removal of superficial lymph-nodes. For deeper anesthesia one has to palpate the transverse process of the second, third and fourth cervical vertebrae—the first is almost a finger's breadth caudal to the tip of the mastoid—and pass the needle medially under each of these, instilling a generous amount of anesthetic solution. If the manipulation is to occur near the mandible, a barrier is required in the superior part of the submaxillary space along the lower border of the mandible to interrupt the cervical and mandibular branches of the facial, mylohyoid and hypoglossal nerves. Since these are so difficult of exact location, it is best to place a barrier plane at the level of the inferior border of the mandible extending 2 or 3 cm. deep in a horizontal plane. Deep lymph-nodes, branchial or thyroglossal sinuses, thyroids, esophageal diverticulae, etc., can be corrected using such a block on one or both sides. Usually 50 to 150 cc. of solution are necessary for each side.

Scalp. For the scalp the simple rule of placing a horizontal barrier across an area roughly six times as long as the desired incision or other manipulation and caudal to this area will produce satisfactory anesthesia, since all the nerves extend fairly straight upward and are therefore interrupted by such injection. Thus lacerations, sebaceous cysts and angiomas can be treated, and even craniotomies can be done.

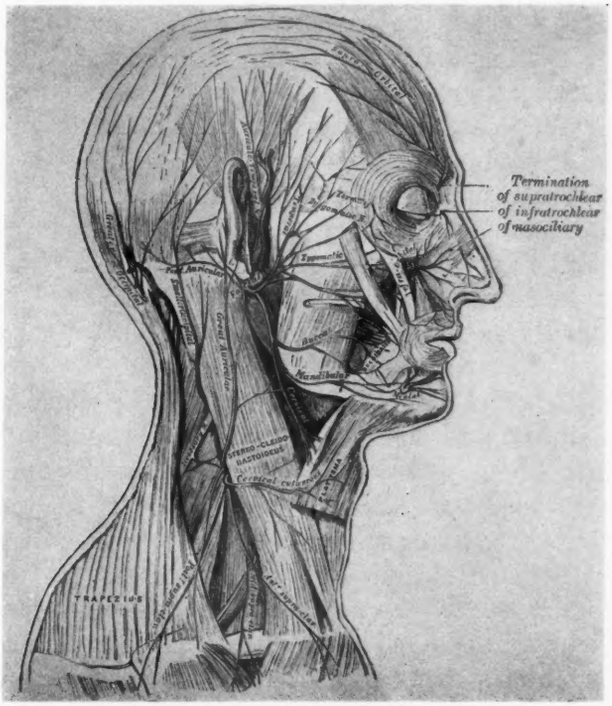

Fig. 6. Superficial branches of cervical plexus and of innervation of scalp and face. (From Gray's Anatomy, 23d Ed. Edited by Warren Lewis. Philadelphia, 1936. Lea & Febiger.)

Face. Injection of the face is one of the most difficult feats in local anesthesia and usually multiple injections are required. However, the supraorbital, infraorbital and submental foramena are palpable and the branches of the nerves can be interrupted as they emerge from these foramena. For extensive work on the face, however, it is necessary to block the semilunar ganglion of the fifth and of the facial as it passes forward anterior to the mastoid process and deep under the parotid gland. Ordinarily, however, small procedures on the face can be done by a

local infiltration with interruption of a conical area by circumferential injection focusing at a point deep to the center of the field.

Special Areas. An area which is particularly prone to infection, such as carbuncle, especially in the diabetic patient, is the back of the neck and the corresponding thick skin of the interscapular region. These can be incised by cruciate incision or completely excised under local anesthesia if one utilizes a wide circumferential injection undermining the infected area to a focal point at the center of the carbuncle, thus placing a conical barrier beneath it. This is necessary because of the bilateral innervation near the midline and the fact that the first posterior divisions of the spinal and cervical nerves are given off just after they emerge from the spinal foramena making them difficult to reach except by paravertebral injection. Usually 20 to 30 cc. of novocain are enough.

Fractures of the long bones can be set in satisfactory and painless fashion by the injection of 30 to 60 cc. of novocain into the hematoma between the broken ends. Of course, the fracture must be recent, preferably within the past twenty-four hours, so that sufficient diffusion of the solution can occur and, again, it is important to allow fifteen to twenty minutes to elapse before testing the anesthesia. This does not seem in any way to interfere with healing, and is a very useful and simple procedure.

Lesions of the breast which are too large for local injection, even radical breast amputation, can be done under a regional block of the corresponding intercostal nerves from first to eighth inclusive, injection into the axilla to interrupt the long thoracic and long subscapular nerves, a barrier along the infraclavicular space deep into the pectoral muscles to interrupt the anterior thoracic branches from the brachial plexus, and a superficial barrier along the midline vertically to interrupt the slight overlap which occurs from the opposite side. Thus regional block of this sort would be required for amputation, plastic operation on the breast and drainage of suppurative mastitis. Simple procedures such as aspiration of a cyst, biopsy and enucleation of fibroadenoma can be done with local injection only.

SUMMARY

The advantages of local anesthesia, particularly for the diabetic patient are pointed out.

The necessary anatomic knowledge is briefly reviewed.

The instruments, technic and other useful details are discussed.

INTRAPERITONEAL INJECTIONS

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NEW ORLEANS, LOUISIANA

THE history of intraperitoneal injections is largely one of decreasing popularity and indications. The prevalence of the skill and facilities necessary for intravenous therapeusis has, in most centers, made intraperitoneal administration of fluids, blood and drugs a substitute procedure. The combination of pneumoperitoneum and *x*-ray examination in the diagnosis of abdominal lesions,[1,2] though never widely practised, has given way to direct examination by means of the peritoneoscope[3,4] in many instances. Vaccination of the peritoneal cavity by the intraperitoneal injection of vaccine has been soundly recommended as a prophylactic measure against the occurrence of peritonitis following surgery of the large bowel.[5–9] A recent report,[10] however, suggests that the use of sulfanilamide may prove to be a valuable procedure in preparing the patient to deal with contamination of the peritoneal cavity sustained during surgery of the various abdominal organs. Only one indication seems to be becoming more important: that is, the intraperitoneal injection of gases as a revocable procedure in the collapse therapy of pulmonary tuberculosis.[11–15] In spite of the obvious general trend away from the use of intraperitoneal injections, there will be some instances when this procedure may be useful. It is with these occasions in mind that the following material concerning the uses and dangers of intraperitoneal injections is presented.

TECHNIC

Various sites have been recommended: the midline below the umbilicus; the lateral border of the rectus muscle;[16] a point one inch to the right of the umbilicus;[17] and just above and to the left of the umbilicus.[15] The region about the umbilicus is usually chosen because no fixed viscera or fixed loops of bowel are normally encountered there. Small bowel underlying this area is normally free to move in any direction to escape puncture by the needle. It is desirable to avoid the round ligament of the liver, the urachus, the inscriptiones tendineae, the cords representing the former hypogastric arteries, and the inferior epigastric arteries. (Fig. 1.) These structures are less liable to be encountered if the puncture is made through a point one inch on either side of the midline and an inch above the level of the umbilicus. These measurements are applicable to adults. In children the distances are decreased but corresponding sites are used.

After ascertaining that the bladder is empty, the skin is prepared with a fat solvent such as ether or benzine, and this is followed by application of a 3.5 per cent solution of iodine in alcohol. The area is draped in a sterile manner. Local anesthesia, by means of infiltration with a 1 per cent solution of novocain, is induced down to the peritoneum. The skin may then be pierced with a sharp pointed scalpel to facilitate the introduction of an 18 gauge needle having a rather short bevel (about 45°) and a slightly dull point. Passage through the peritoneum is easily detected by the sudden loss of the sense of resistance. Daniels and Eisele[15] have attached the needle to a syringe filled with air, and as the peritoneum is approached, pressure is made upon the plunger of the syringe. As soon as the needle pierces the peritoneum, both the "give" of the needle in passing through it and the release of pressure against the plunger in the syringe signify that the peritoneal cavity has been entered. In children the abdominal wall may be

"pinched up" in order to displace loops of bowel, thus avoiding puncture of the intestine.

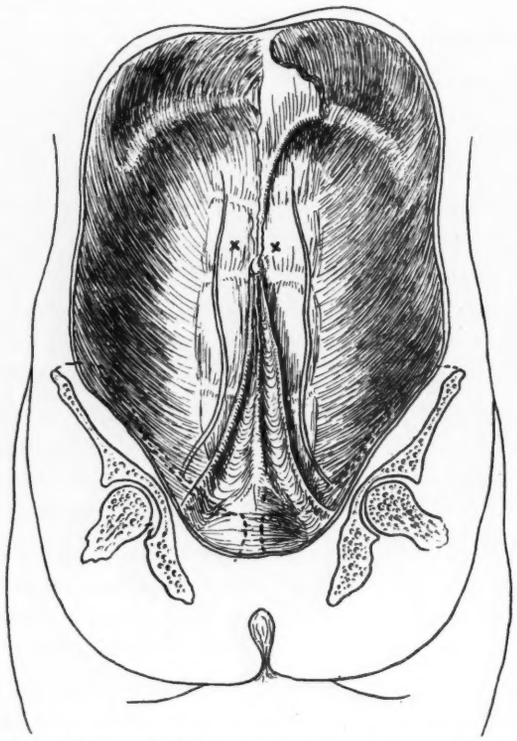

FIG. 1. View of the inner surface of the anterior abdominal wall showing the structures to be avoided in intraperitoneal puncture and indicating (x) the sites at which punctures will be least liable to encounter these structures.

DANGERS AND COMPLICATIONS

One gains the impression from the literature that intraperitoneal injection is rarely complicated by accidents or undesirable sequelae. However, it is possible that many unhappy experiences with this procedure have remained unrecorded. At any rate, passing a needle through the abdominal wall is not totally devoid of risk.

Perforation of the intestine is the first danger to be kept in mind. This risk was emphasized by Blackfan and Maxcy[18] in 1918, and again by Ravenel[19] in 1933. The latter author reported a fatal instance of septic peritonitis following puncture of the intestinal tract sustained during the course of intraperitoneal injection. The opening in the bowel resulting from puncture by a needle of the size ordinarily used in performing intraperitoneal injection probably closes spontaneously in most instances by herniation of mucosa or sealing off with plastic exudate.

Puncture of the intestine is more liable to occur when loops of bowel are not free to escape the needle, as may obtain in the presence of peritoneal adhesions or distention of the bowel. The thin bowel wall in the latter situation increases the possibility of perforation. The presence of ascites with an already increased intra-abdominal tension and decreased absorptive power of the peritoneum is an obvious contraindication for the intraperitoneal injection of fluid or blood. Ravenel[19] has called attention to the possibility that the hypogastric arteries may remain unobliterated for longer than the usual two or three months.[20] He reported two instances of serious hemorrhage following damage by puncture to such vessels.

Grulee[17] considers the presence of an acute infection a contraindication for intraperitoneal transfusion. He expressed the opinion that disturbance or damage to the peritoneum may cause a locus minoris resistentiae and may subject the peritoneum to bacterial invasion via the blood stream. It seems reasonable to suggest that the same risk may exist in the intraperitoneal injection of saline and dextrose solutions under similar circumstances.

AGENTS USED

In infants and children the agents introduced into the peritoneal cavity most frequently have been saline[18] and dextrose[21] solutions to combat dehydration and to supply carbohydrate. These fluids should be given at a temperature of 105°F. The amount given varies from 100 to 400 c.c., depending upon the size of the patient. Fluids may be given to the point of mild distention, which soon disappears, but marked distention should be avoided because of the decreased absorption by the peritoneum and upward displacement of the diaphragm. The absorption of amounts of fluid up to 200 cc. should occur in four to five hours. Thus, several punctures daily

may be done, permitting the introduction of sufficient fluids to maintain a satisfactory fluid balance.

Intraperitoneal transfusion of citrated blood was studied in animal experiments by Siperstein and Sansby.[22] They showed that both cells and serum were absorbed by the peritoneum. Siperstein,[23] in 1922, reported good results from the clinical use of the method. It is not widely practised at the present time in most centers because the objection has been raised that the absorption of citrated blood by the peritoneum is liable to be too slow to be effective. This route obviously has no place in the treatment of shock and hemorrhage, in which prompt restoration of a satisfactory volume of circulating blood is urgently needed. However, it may be used in the correction of anemia when lack of facilities or sufficient skill do not permit intravenous transfusion. Cross-matching of the blood is necessary for intraperitoneal use, just as it is for the intravenous method of transfusion. The amount of blood given is based on the same factors as is the use of saline and dextrose solutions intraperitoneally. Either the gravity method or the multiple syringe (100 cc. syringes) method may be used.

Stein and Stewart[1] have traced the history of the use of pneumoperitoneum combined with roentgenography in the diagnosis of intra-abdominal lesions. The outlines of the liver, spleen, kidneys and gallbladder, and the presence of intraperitoneal adhesions may thus be demonstrated. With the increasing use of the peritoneoscope, direct inspection will probably replace the combination of pneumoperitoneum and roentgenography, but the latter procedure may still have a limited field of usefulness.

The therapeutic use of oxygen injected intraperitoneally in patients with tuberculous peritonitis has been described by Stein[24] but has not been widely practised. The uncertainty of the response and the difficulty of determining the presence and location of adhesions will deter many from attempting this form of therapy.

Inflation of the peritoneal cavity for its collapsing effect on the lungs was first used by Vajda[11] in 1933. The reports of Banyai,[12,14] Trimble and Wardrip,[13] and Daniels and Eisele[15] indicate its definite value in the collapse therapy of pulmonary tuberculosis. An average of 600 to 700 cc. of oxygen are used, and refills of approximately 500 cc. are given weekly. During the production of artificial pneumoperitoneum for either diagnostic or therapeutic purposes, the additional risk of air embolism is to be added to the hazards of intraperitoneal injection already mentioned.

The mortality from peritonitis following surgery of the large bowel prompted the development of peritoneal vaccination with colibactragen, a suspension of B. coli in tragacanth prepared according to the method of Steinberg.[9] Bargen and Rankin[5,6] and Potter and Coller[8] obtained good results with this method, but the use of sulfanilamide as a prophylactic measure in abdominal surgery, as described by Lockwood and Ravdin[10] may result in a decrease in the use of peritoneal vaccination.

SUMMARY

Although it is apparent that the popularity and general indications for intraperitoneal injections are decreasing, there remain some instances when this procedure may be useful. Therefore, its technic is described, the dangers and possible complications are emphasized, and some of the essential points in the intraperitoneal injection of fluids and gases are presented.

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INTRAVENOUS INJECTIONS AND INFUSIONS

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THE discovery of the circulation of blood by Harvey, announced in 1628,[1] was soon followed by attempts to introduce various substances into the blood stream. Sir Christopher Wren is given credit[2] for performing in 1657 the first intravenous injection of a drug in man. According to Matas,[3] the use of intravenous saline solution was first successfully practised by Joenichen of Moscow in 1830. Matas,[4] in 1891, reported good results in surgical patients treated for shock, hemorrhage or "exhaustion" by intravenous saline infusion. Extensive studies of the cause of unfavorable reactions following intravenous therapy[5–9] and of the mineral and water metabolism of the body[10–13] have made possible the safe and rational intravenous administration of relatively large amounts of fluid.

Intravenous injection is the term applied to the introduction of small amounts of solutions (1 to 20 cc.), usually by means of a syringe. Intravenous infusion indicates the introduction of amounts of fluid larger than can ordinarily be contained in a syringe. Fluids given in this manner are usually allowed to run into the vein by the force of gravity although their introduction may be hastened by "milking" the rubber delivery tube.

The indications for the introduction of solutions directly into the blood stream may be classified as follows:

I. To obviate a period of absorption.
   (*A*) When immediate or early effect is desired, as in:
      1. Drug therapy (epinephrine, insulin, dextrose, morphine, barbiturates and antisera).
      2. Fluid therapy (saline, dextrose, buffer, or acacia solutions used to restore effective circulating blood volume in shock or hemorrhage and to correct dehydration, alkalosis or acidosis).
   (*B*) When a definite amount of a substance is wanted in the blood stream (kidney and liver function tests and gallbladder visualization).
   (*C*) When the moment of entrance of a substance or solution into the blood stream must be known (as in determinations of circulation time).

II. To allow parenteral administration of substances which would cause pain or damage to the tissues if given subcutaneously or intramuscularly (hypertonic saline, dextrose, or sucrose solutions, arsenical preparations, calcium chloride or calcium gluconate).

III. To introduce substances for the purpose of damaging the wall of a vein, as in varicose veins (sodium morrhuate, concentrated sugar solutions, quinine and urethane, monolate, quinine and urea hydrochloride).

TECHNIC

The veins commonly used for intravenous injections and infusions are shown in Figure 1. In infants, injection into the superior longitudinal sinus is to be done only when attempts to use all other intravascular routes have failed. By far the safer procedure is to expose a vein which has a constant location, even though it may not be visible or palpable with the skin intact. For intravenous injections which last only a few minutes, even an uncomfortable position may be maintained if it provides an easy approach to a suitable vein. On the contrary, when infusions which may run for a few hours or veno-

clyses which may be continued for days are to be given, a comfortable position for the patient must be provided. Immobilization of the arm in complete extension at the elbow with the palm turned upward causes discomfort in a short time. A comfortable position is shown in Figure 2.

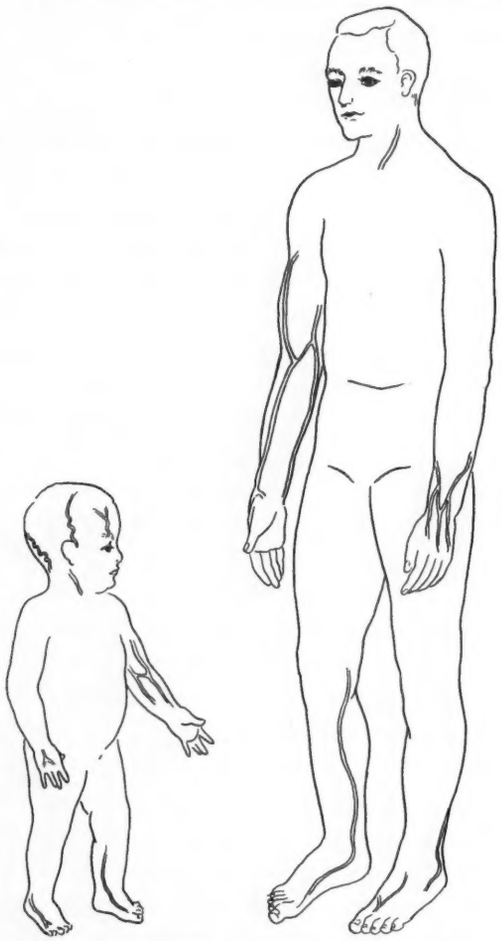

FIG. 1. Veins usually accessible for intravenous therapy in children and adults.

In performing venipuncture, the skin is prepared by using a fat solvent, as ether or benzine, followed by 3.5 per cent tincture of iodine. A tourniquet or the cuff of a blood pressure apparatus is applied to render the vein visible or more prominent but often the vein must be located by palpation alone. A 19 or 21 gauge needle is suitable for the venipuncture. Blunt needles frequently tear the vein wall and therefore less difficulty will be encountered if a sharp needle with a moderately long bevel is used in conjunction with a practised sense of touch. The patency of the lumen of the needle and the absence of a bur at the tip should be demonstrated before attempting to enter the vein. Local anesthesia, if desired, is easily accomplished by intracutaneous and paravenous infiltration with 1 per cent novocain solution. The vein may be obscured temporarily but massage will soon disperse the injected anesthetic solution and a painless puncture is then possible.

As a rule, the skin is pierced separately unless it is thin. If the skin is thick and resistant, a small puncture wound through which the needle is passed may be made with a bistoury. The needle, with the bevel up, should then be directed at an angle of about 45 degrees from the vein. (Fig. 3.) After the needle pierces the skin, the needle is turned so that the bevel is down, and the approach is then made from the side, with the tip of the index finger of the free hand supporting the opposite side of the vein. (Fig. 4.) The thumb further immobilizes the vein by stretching the overlying skin gently. In this way the vein may be immobilized so that it will not escape the thrust of the needle. Blood should enter the needle spontaneously if the venous pressure is within normal limits. The sensation of piercing the vein wall is sufficiently definite to render infrequent the mistake of puncturing the opposite wall, which should happen only in small veins, where there is a disproportion between the size of the vein and the size of the needle. When difficulty is encountered in entering a vein, another site should be used, as the trauma attendant on repeated attempts is conducive to early clotting of the blood which enters the needle when the puncture is finally accomplished. After the tip of the needle has entered the vein, the angle at which the puncture was made is decreased. In giving infusions, the needle should be passed upward into the vein for a distance of 1 to 2 cm. so that only a great disturbance will dislodge it. (Fig. 3.) When it is ascertained that no air is present in the tubing, the introduction of the solution

should begin at once as delay at this point may permit clotting.

When infusions are given, the needle should be fastened in a position which does not cause angulation of the vein and which does not permit the bevel to rest against the vein wall. (Fig. 3.) When irritating substances are injected into the blood stream, the syringe should be rinsed with blood so that a damaging concentration of the solution will not leak from the opening in the vein when the needle is withdrawn. Upon removing the needle, pressure and massage should be applied immediately over the site of puncture to prevent hematoma and to stimulate contraction of the vein to aid in closing the puncture wound in its wall.

Fig. 2. Arm in position naturally assumed by a patient in the supine position. Needles in three commonly used veins. The needle may be introduced while the palm is upward and if it is properly inserted into the vein it will not be disturbed by the change to this comfortable position.

In patients suffering from shock, in whom the veins are collapsed, or in debilitated patients with small, thin-walled veins, it is often necessary to expose a vein by incising the overlying skin. No hesitancy should be entertained about doing this in such patients, as it makes the introduction of fluids into the vein almost a certainty and rarely does any difficulty arise from the ligation of the vein. Gallie and Harris[14] recommend the use of a small vein when direct exposure is necessary as clotting is less liable to occur in the presence of the increased rate of flow at the site of introduction when small vessels are used.

The technic of exposing a vein follows established surgical principles and is accomplished as shown in Figure 5. The skin is prepared by using a fat solvent, as ether or benzine, followed by 3.5 per cent tincture of iodine. Suitable sterile drapes are not only actual protection for the area involved but also serve as reminders that strict asepsis is to be maintained throughout the entire procedure. Local anesthesia is entirely satisfactory, the infiltration of the skin and the subcutaneous and paravenous tissues being somewhat more extensive than that described for simple venipuncture. A transverse incision ½ to 2 cm. long, depending on the amount of subcutaneous tissue present, is made directly over the vein. The subcutaneous tissue is separated from the vein by blunt dissection parallel to the vessel, using a small curved hemostat. The entire circumference of the vein must be freed for a distance of about 1 cm. before it is encircled by two ligatures of fine silk or catgut. The distal ligature is tied. Traction on the proximal ligature or the use of a small bulldog blood vessel clamp will prevent loss of blood when the vein is opened. By upward traction on both ligatures the vein is immobilized. A fine pointed bistoury is passed transversely through the wall of the vein at two opposite points and is then drawn distally and upward to make a flap in the vein wall. An alternate method with fine scissors may be employed. By grasping the tip of the flap and the ends of the incision in the vein with fine mosquito forceps, a suitable cannula may be intro-

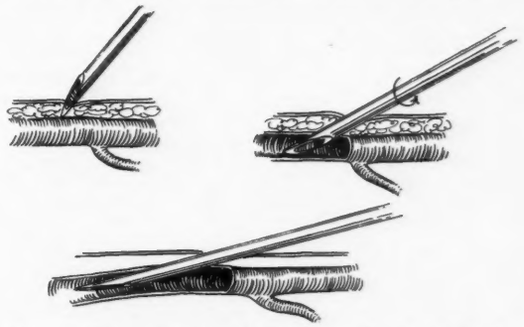

Fig. 3. Vein wall pierced with needle at an angle of 45 degrees to avoid passing the needle along the sheath of the vein. After the tip is introduced the angle is decreased, the bevel turned down and the needle passed into the vein for a distance of 1 to 2 cm.

duced and tied in place, using a bow knot. The necessary skin sutures are put in place while the local anesthetic is still effective.

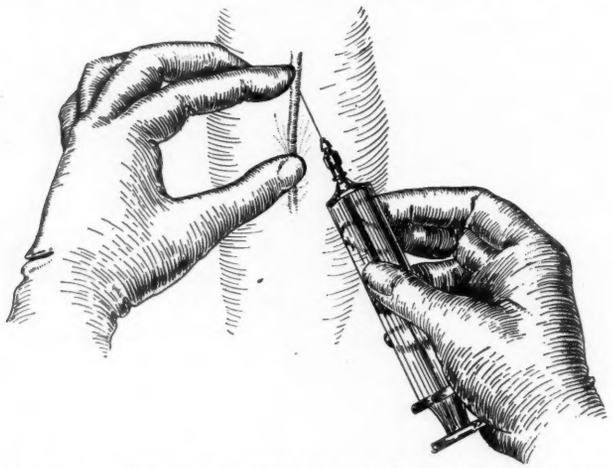

Fig. 4. Technic of venipuncture. Vein is immobilized by support from the tip of the index finger and by stretching the overlying skin with the thumb. The coordinated use of tactile sense in both hands is made possible by palpating the vein with the tip of the index finger of one hand and grasping the syringe in the fingertips of the opposite hand.

When the infusion is completed the bow knot is untied, the cannula is removed and the ligature is tied permanently. The skin edges are approximated by the stitches which are already in place.

In instances in which the necessity for the intravenous administration of fluid is expected to be present for many days, the most distal part of a vein should be used first so that local obliteration by ligature or by thrombosis will not interfere with the use of the proximal portions. The intravenous administrations may be continuous, as first practiced by Matas[3] and so staunchly recommended by Horsley[15] and Hendon.[16] Venoclysis, the name popularized by Hendon for this form of therapy has been used for as long as nineteen days without clotting, but the average time it will run uninterruptedly is about five days. A flow of 500 cc. per day is regarded as sufficient to prevent clotting.[14] Saline solution in physiologic concentrations has been found to be associated with thrombosis in venoclysis less frequently than dextrose solution. At any time, in either the interrupted or the continuous method of administration, fresh or preserved blood, plasma or serum may be substituted for other fluids.

At present it is well recognized that bacterial contamination is usually the cause of "reactions," and the temperature of solutions and the rate of their administration now receive less attention as possible causes. The rate of administration varies according to the solution. Drugs and chemicals should be injected slowly enough so that an undesirable concentration will not be present to damage the vein wall or to reach vital centers and cause an unfavorable response. Some drugs such as the barbiturates are given at a rate not exceeding 1 cc. per minute to guard against overdosage.

In giving larger amounts of fluid, the rate of administration is governed by several factors. By far the most important ones are the capacity of the vascular system and the ability of the heart to propel the increasing volume of blood. In shock or hemorrhage, the prompt restoration of an effective circulating blood volume is desirable. Under such circumstances, the fluid should be given at a rate of from 20 to 40 cc. per minute until the pulse and blood pressure show satisfactory improvement.

The rate may then be reduced. Gilligan et al.[17] have shown that in patients not in shock the greater increases in total blood volume occur with the faster rates of administration and that these increases persist longer. For simple fluid replacement a flow of 200 to 400 cc. per hour is generally regarded as safe in adults without cardiovascular disease. If a 10 per cent dextrose solution is used, it may be given at a rate of 300 to 500 cc. per hour with an average loss of only 5 per cent of the dextrose by "spilling over" into the urine.[18] According to Schwentker,[19] 10 cc. of solution per pound of body weight may be given intravenously to children up to four years of age. In severe dehydration in infants under two years, the amount may be increased to 15 to 20 cc. per pound. It should be given at the rate of 3 cc. per minute.

Aside from known idiosyncrasies and contraindications based on the nature of the substance to be injected, the contraindications for intravenous therapy are relatively few. They concern chiefly those states in which the body already has too much water, either generally or in one particular area, or when there will be difficulty in removing water if it is given in excess quantities. Thus, patients with severe heart or kidney disease, those in congestive failure, and those with pulmonary edema or edema of nephritic origin should not be given fluids intravenously. The question of how much fluid to give intravenously is too extensive to discuss here except to say that as a rule it is safe to introduce 3,000 cc. of fluid daily, according to a well spaced schedule, in patients not having a basis for the above contraindications.

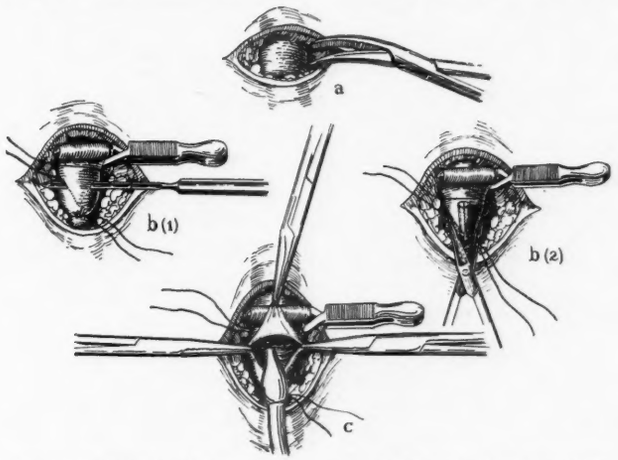

FIG. 5. Technic of exposing a superficial vein for insertion of a needle or a cannula. Cutting instruments are used only to divide the skin and to open the vein. The vein is isolated entirely by blunt dissection. With this technic a cannula slightly larger than the vein can be inserted.

DANGERS AND COMPLICATIONS

The dangers and complications may be local, as slough from paravenous injection of irritating substances, thrombosis of the vein or infection. The general dangers and complications are more numerous and more serious. In the administration of relatively large amounts of fluid, pulmonary edema is one of the most frequent undesirable results. Pulmonary embolism and air embolism are infrequent. Anaphylactoid reactions must be regarded as a source of danger in intravenous serum therapy. In patients who have lowered concentration of serum protein from any cause, the possibility of producing edema is always present. Continuous drip infusion may deplete the patient's protein stores[20,21] if continued too long, or it may cause pulmonary edema in a patient who would tolerate interrupted administration of smaller amounts of fluid. Edema from salt retention may occur in

patients with arteriosclerotic changes in the kidneys. Dependent edema is a warning signal that too much fluid or too much salt is being given and this sign should not be disregarded, as internal edema will soon follow. Dilatation of the heart may occur from the too rapid administration of fluid and its onset is heralded by a dry cough.[22]

SUMMARY

The indications for intravenous injections and infusions are classified. Technics for venipuncture and venoclysis are described. Some essential points dealing with fluid replacement are reviewed. The more common dangers and complications of intravenous therapy are presented.

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INTRAVENOUS ANESTHESIA IN MINOR SURGERY

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THE ideal anesthetic agent for use in minor surgery is one which meets the following qualifications: (1) It must have a reasonable margin of safety; (2) anesthesia must be induced with speed and yet with comfort to the patient; (3) the after effects of the agent must be minimal; (4) its administration should not be too complicated, and (5) it should, if possible, be nonexplosive. Sodium pentothal has properties which meet the above requirements. Lundy[1] and his associates at the Mayo Clinic have just reported the use of this barbiturate in more than 18,000 instances from 1934 to 1939 inclusive. It is very interesting to note the growth in the use of this anesthetic at the Mayo Clinic, where more intravenous anesthesia is done than in any other American clinic. In 1934 only seventy-three patients received pentothal sodium; in 1937 the number was 3,810 and in 1939 the drug was used in 5,874 instances.

I[2] first used intravenous anesthesia in the Allgemeines Krankenhaus, Vienna, in the clinic of Dr. Hellmut Kamniker. At that time, in 1933, a few months after its synthetization in Germany, we were using evipan. This drug, which is known as evipal in this country has the following formula: Sodium N-methylcyclo-hexenyl-methyl-barbituric acid. Pentothal is sodium ethyl l-methyl butyl thiobarbituric acid. These two drugs are fast acting barbiturates in contradistinction to the slower acting drugs such as sodium amytal, nembutal, luminal, diallyl barbituric acid, pernocton and neonal. The slower acting barbiturates have been shown to give good anesthesia in the majority of cases, but pulmonary edema and bronchopneumonia are complications which make the use of these drugs dangerous. With pentothal, however, we do not see any more postoperative complications than we do with any of the inhalation anesthetics. It is my firm opinion in over 1,000 intravenous anesthesias that I have done, that pulmonary conditions are less frequent after intravenous anesthesia than with any other type. When the time of anesthesia is moderately short, as it usually is in minor surgery, the danger of any complication is, of course, correspondingly less.

Patients invariably state that they like pentothal anesthesia. Many patients who have taken ether or nitrous oxide are a little afraid to take inhalation anesthesia again, and they worry about the nausea and vomiting which may have been severe in their particular cases. Some patients may have a cold or feel indisposed, and yet an anesthetic must be given for perhaps a carbuncle, simple fracture, dislocation or to drain a felon. In minor surgery I would list the following procedures as satisfactory for pentothal anesthesia: (1) To open a boil; (2) biopsy of a lymph node; (3) to remove a small tumor, cyst or wart from the skin; (4) to dilate an abdominal sinus for better drainage; (5) to set a simple fracture; (6) to reduce dislocations; (7) to excise a thrombosed hemorrhoid; (8) cystoscopy and ureteric catheterization; (9) dilatation and curettage of the uterus; (10) to control convulsive states such as dementia of various kinds and delerium tremens; (11) to treat fresh burns, and (12) to suture lacerations.

The dangers of the intravenous use of pentothal are: (1) respiratory depression; (2) cyanosis; (3) fall in blood pressure; (4) liver damage, and (5) injury to the tissues by extravenous solution. Regarding the first of these points, all of which must be watched most carefully, it is a sina qua non to intravenous anesthesia (just as with inhalation) that oxygen be immediately

available. While in the great majority of cases no oxygen or only a little (especially in minor procedures) is needed, it must be placed in the room before the operation starts. I have had to maintain artificial respiration in only a very few cases, and in those instances the pentothal had been used in large dosages. Cyanosis will be present in greater or less degree frequently. in 23 per cent of my cases I have found slight to severe cyanosis. This is due in part to the decrease in the excursion of the respiratory cage, a phenomenon which occurs in 85 per cent of all intravenous anesthesias; but if watched for and if treated by the administration of oxygen as soon as it starts, there seldom will be any severe embarrassment to respiration. A fall in blood pressure of usually 20 mm. of mercury occurs in every instance. This is transitory and there is a gradual recovery period which becomes complete with the return of consciousness. I have never seen any catastrophic fall in blood pressure with pentothal. In fact, in major surgery, I frequently use pentothal intravenously together with spinal anesthesia, although in these instances less pentothal is used than if the intravenous method alone was being employed. Jaundice is a rare complication and I have seen only two cases which might be attributed to pentothal. Both of these patients had a large amount of the drug. One was a man, aged 80, who had a perineal prostatectomy under 1,275 mg. in fifty minutes, and no other anesthesia was used. The jaundice lasted only two days, came on thirty-six hours after operation, and as far as could be ascertained, was not of serious import. If pentothal is accidentally injected into the tissues around the vein, there will be moderate to severe inflammation, sclerosis and ulceration, depending upon the amount. Obviously, this is a matter of improper technic in inserting the needle. I like to use the veins upon the dorsum manus, the cubital fossa, the accessory cephalic and the vein which is always found over the internal malleolus. One should use a No. 19 needle, although a No. 20 or even No. 22 may be used in very small veins.

If one is unfamiliar with intravenous anesthesia, he should first use the drug in cases which are to be of short surgical duration and upon patients who are in good physical condition. There is no set formula in the administration of this drug. Experience, and experience alone, will tell the anesthetist how much to use and in what cases. I have used as much as 3,500 mg. as the only anesthetic in the removal of four ribs in a severe case of empyema, and I have used as little as 200 mg. for the removal of a fingernail, or even of a carcinoma by cautery in a second stage Mickulikz operation. Its use in major surgery is discussed in a recent article by the author.[3]

ADMINISTRATION OF PENTOTHAL SODIUM INTRAVENOUSLY (DR. LUNDY'S TECHNIC)

Pentothal sodium comes in 1 gram ampoules, and is a white powder which is easily soluble in water. The following material is necessary for mixing up the solution and preparing the syringes:

1. 50 cc. distilled water
2. Sterile glass 50 (fifty) cc. quantity
3. An ampoule of pentothal sodium
4. Two 20 cc. glass (sterile) syringes with glass plungers
5. Two No. 19 needles
6. One No. 20 needle (in case of small vein)
7. Alcohol 70 per cent for sterilizing skin
8. Tourniquet
9. Sterile towels to drape arm
10. Arm board and tape
11. Oxygen tank and mask
12. Saw to cut ampoule

First, open the ampoule of pentothal. Then suck up 20 cc. of distilled water into one of the syringes and inject this into the ampoule thereby dissolving the contents (by barbotage). This will produce a 5 per cent solution of pentothal. Lundy has clearly shown that the 2½ per cent solution

is the better strength to use, and this means, of course, that the 20 cc. of 5 per cent solution must be added to 20 cc. of distilled water in the glass cup. This will make two 20 cc. syringefulls of 2½ per cent solution of pentothal each containing 500 mg. of the drug. Before administering the solution it is most important that the patient be given a sedative such as nembutal grains 1½ about one-half hour before the operation. Morphine, too, should be given, from ⅙ to ¼ grains depending upon the strength and size of the patient. If the pentothal is given without the preoperative medication outlined, it will be necessary to use from 25 to 100 per cent more solution in order to obtain the desired anesthesia. Insert the needle into the selected vein and ask the patient to start to count slowly and in good voice. Inject 4 cc. slowly (5 seconds); wait 20 seconds and inject an additional 2 cc. Usually at about the count of fourteen to eighteen the patient will sigh, or the voice will become softer, or he will count more slowly. It may be necessary to inject a total of from 8 to 10 or even 12 cc. in a period of two to three minutes before the patient is asleep. Just before the surgeon starts to operate introduce 2 to 3 cc. of the drug and watch the patient carefully for movements of the hands, eyebrows, etc. It is often possible for the surgeon to operate upon a minor case without having the patient completely out. It is quite unnecessary to put the patient into complete, deep anesthesia, and this is the most important stage of the procedure. Keep the patient's chin up and establish a good airway; if necessary, use a wire airway. Laryngeal spasm is an important complication which may come on if one does not keep the respiratory tract clear. For this reason it is always wise to give atropine 1/150 whenever one can do so. If spasm does supervene, put gentle pressure upon the chest every six seconds and give oxygen freely. In testing the level of anesthesia, it is a good idea to pinch the skin of the axilla just before the surgeon is to begin.

For dilatation and curettage the usual dose is about 400 to 700 mg. in a space of twelve minutes. To open an abscess one should give 250 to 450 mg. With doses such as these, the patient will awaken in five to fifteen minutes. It is better not to awaken the patient, but let him sleep for a few minutes after the procedure has been completed. When large doses, anything over 1,200 mg., have been given, it is not at all unusual for the patient to sleep for two to eight hours postoperatively.

It is an absolute fact that patients like intravenous anesthesia better than any anesthetic agent that has hitherto been devised. The majority of them will tell you spontaneously how much they enjoyed taking it. This is especially so when there has been a previous unpleasant experience with ether or some other inhalant.

A surgeon should under no circumstance give this anesthesia and then operate upon the patient himself. I am positive that the best manner to give the drug is for the anesthetist to stand at the operating table, keep his finger upon the needle in the vein and introduce the solution as he sees fit. I am definitely opposed to the administration of pentothal by sticking the needle into a saline that is running in, or by fastening the pentothal syringe to the saline tube by means of a Y-connection. The giving of pentothal should be the complete work of one man, and only by keeping his fingers on the syringe and the vein being used, does he have complete and positive control of the anesthetic. In this way the anesthetist will always know exactly how much has been given, and having followed the case along throughout the entire procedure he will be qualified to tell just how much more of the drug the patient needs. If an intravenous injection is needed, another vein in the other arm or leg should be used.

CONCLUSIONS

Intravenous anesthesia is of great value in minor surgery for the following reasons:

1. It is easy to administer if certain rules are followed.

2. It is nonexplosive and may be used in the presence of electrocautery and flame.

3. There are practically no after effects; nausea and vomiting are rarities.

4. It can be used for short procedures, the patient being able to walk home (accompanied) afterwards.

5. It has as wide if not a wider range of safety as has ether.

6. Its greatest use is in cases in which complete deep relaxation is not required.

7. The 2½ per cent solution administered according to the Lundy technic is the best method when using sodium pentothal.

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One of the greatest difficulties of spinal analgesia lies in the drop in blood-pressure that is produced . . .
From—"Rose & Carless Manual of Surgery," Edited by William T. Coughlin (The Williams & Wilkins Company).

PARACENTESIS ABDOMINIS

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PARACENTESIS abdominis, puncture of the abdominal cavity, may be done for the following purposes: (1) To remove ascitic fluid for palliation; (2) to remove fluid from the peritoneal cavity for gross and microscopic examination as an aid in diagnosis; (3) to produce pneumoperitoneum; (4) to introduce a peritoneoscope for direct visualization of the peritoneal cavity and its contents; and (5) to inject various therapeutic agents into the peritoneal cavity.

Perforation of a viscus and hemorrhage are the serious complications of paracentesis abdominis and are most likely to occur if puncture is done at a point at which the bowel is fixed to the abdominal wall by adhesions or at which a viscus is fixed by normal peritoneal attachments. The site selected for puncture should be away from the regions of fixed viscera. The site of puncture usually chosen for removal of ascitic fluid is below the umbilicus in the median line or lateral to the course of the deep epigastric vessels. The bladder should be empty at the time of operation. Puncture should not be performed if intraperitoneal adhesions are suspected or known to be present. In instances in which adhesions are present and the removal of fluid is necessary, it is better to incise the abdominal wall and carefully open the peritoneum under direct vision. The reports of Ruddock[1] and Pflaum[2] indicate the frequency and seriousness of this complication when paracentesis is done blindly. Pflaum found ten cases of peritonitis incident to paracentesis among 1,000 fatal cases of peritonitis. Ruddock reported eight instances of perforation of the bowel in 500 patients upon whom peritoneoscopy was performed.

If the bowel is perforated with a needle, it is unlikely that serious trouble will follow, as the opening is usually promptly plugged by mucosa and sealed over by peritoneum. Patients in whom such an accident is suspected should be kept under observation in bed for a few days and peristalsis during this period should be limited by proper care. If the bowel is perforated with a trocar, it is best to operate immediately and close the opening in the bowel wall.

REMOVAL OF ASCITIC FLUID

Paracentesis for the removal of ascitic fluid is a procedure that is frequently performed. Fontaine[3] and Marbel[4] have described special cannulas for this purpose. Perforation of the bowel is unlikely when paracentesis is done for ascites due to liver, kidney or heart damage because intraperitoneal adhesions are usually absent. After repeated tappings, adhesions may form at the sites of puncture and the danger of perforation of the bowel then increases. In ascites associated with tuberculous peritonitis, perforation of the bowel incident to abdominal puncture is more likely to occur. Occasionally shock, and rarely death, follows rapid removal of large quantities of ascitic fluid. A possible explanation for this complication is found in the studies of Brams, Katz and Kohn.[5] They observed that after release of marked abdominal distention which had been present for some time the arterial pressure dropped as much as 40 mm. of mercury. The gradual withdrawal of fluid, the application of a tight binder as the fluid is being removed and the replacement of fluid by air are precautions that may be exercised to prevent this complication.

As long ago as 1923, Maes[6] made a plea for more frequent exploration, through a suitable incision, of patients with ascites. He stated, "In all such cases the underlying pathology will be rendered less obscure and the patient's chances of complete or partial relief materially improved if exploratory laparotomy is substituted for simple paracentesis."

DIAGNOSTIC PUNCTURE

Denzer,[7,8,9] Neuhof and Cohen,[10] and Johnston[11] have reported the use of puncture of the abdomen for diagnostic purposes. In this procedure, puncture of the peritoneum is performed with an 18 or 20 gauge needle and aspiration done. If fluid is found, its gross and microscopic characteristics are studied. This procedure is considered a valuable aid in the diagnosis of obscure acute intra-abdominal disease and is particularly valuable in the diagnosis of pneumococcal and streptococcal peritonitis, conditions in which operation is not the treatment of choice. Gross blood or bloody fluid is significant in traumatic cases. In rupture of the bladder, the fluid has the characteristic odor of urine. In acute pancreatitis, a beef-juice-colored fluid with an oily appearance may be found. A yellow fluid with a sour odor has aided in the diagnosis of a ruptured peptic ulcer. Microscopic study of a stained smear should give sufficient information for the diagnosis of streptococcal or pneumococcal peritonitis.

The technic of diagnostic puncture[10] is not difficult and is considered a safe procedure.[9] Negative punctures are of no diagnostic value. Neuhof and Cohen[10] make the following statement in regard to negative puncture: "If in any given case the decision has been reached that operation is indicated, whether for a traumatic or an inflammatory intraperitoneal lesion, operation should be proceeded with absolutely regardless of a negative puncture."

If the diagnosis is clear, puncture is obviously not indicated. It is contraindicated in a chronic or subacute lesion that may have caused fixation of a portion of the bowel and in acute peritoneal infection in which a mass is present.

PNEUMOPERITONEUM

Gas is injected into the peritoneal cavity for both diagnostic and therapeutic purposes. Air, oxygen, carbon dioxide and other gases have been used for the induction of pneumoperitoneum, and the effects of various gases on the peritoneum and general health have been studied. Air is considered satisfactory, but the choice of gas depends on the purpose for which pneumoperitoneum is performed.

Pneumoperitoneum for roentgenographic studies of the abdomen was introduced by Weber in 1912 but in this country Stewart and Stein[12] first reported its use in 1919. Very little has been reported on this procedure in the literature during recent years. Sante[13] and Martin[14] have described the technic for this type of study. Martin,[15] in a recent discussion of pneumoperitoneum for diagnostic purposes, commented, " . . . it has never received the recognition that it deserves."

Pneumoperitoneum is used in the treatment of pulmonary, peritoneal and intestinal tuberculosis. In 1930, Overholt[16] demonstrated experimentally the elevation and immobilization of the diaphragm that is produced by pneumoperitoneum. In 1933, Vajda[17] used this procedure for the treatment of pulmonary tuberculosis. Since then, there have been many reports on the value and use of this form of therapy for pulmonary tuberculosis.[18–23]

Pneumoperitoneum has a limited use in the treatment of pulmonary tuberculosis. Stokes[21] points out that where other measures either fail or cannot be used pneumoperitoneum may be of help in the control of hemoptysis and the reduction of toxemia.

PERITONEOSCOPY

Visualization of the peritoneal cavity and its contents by an optical instrument was first reported by Kelling in 1901. Reports of this procedure have appeared occasion-

ally in the literature since that time. Ruddock[24] recently revived interest in this operation and in 1938[1] he reported a series of 500 patients upon whom he had performed peritoneoscopy. He developed and described a peritoneoscope and the technic that he has found so satisfactory. He advocates the use of peritoneoscopy to determine malignancies and their extent of involvement, to differentiate and localize tumor masses, to confirm diagnoses and to obtain biopsies. To be successful, the operator must train himself in the details of the procedure and should be able to recognize and differentiate gross pathologic changes. Peritoneoscopy is contraindicated in patients with inflammatory lesions of the peritoneum.

The complications of peritoneoscopy are commented upon by Ruddock[1] who reported eight instances of perforation of the bowel in 500 patients on whom this procedure was done. In each instance, perforation was recognized at the time it occurred, laparotomy immediately performed, the trocar removed and the perforation closed. One patient in Ruddock's series died from hemorrhage following biopsy of the liver, probably due to incomplete coagulation of the biopsy wound. Thieme,[25] in a critical review of peritoneoscopy, reported a series of fifty patients on whom this procedure was performed. He used the technic described by Ruddock. Thieme considered the method safe and accurate and stated that much of the information usually gained by laparotomy can be obtained by this procedure without the expense or mortality of a major operation.

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SPINAL PUNCTURE

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QUINCKE of Magdeburg is given credit for the introduction of lumbar puncture. In 1891, he reported the use of lumbar puncture to relieve the symptoms of hydrocephalus. Corning of this country used lumbar puncture six years before, but, as pointed out by Collier,[1] Quincke was the first to make his work known throughout the world. The diagnostic importance of a spinal fluid study was soon recognized and today spinal puncture is a routine procedure in diagnosis and treatment.

New routes have been described by which the cerebrospinal fluid may be withdrawn for diagnostic study, or the subarachnoid spaces reached for therapeutic purposes (cisternal, ventricular), but spinal puncture is still the choice in the majority of instances. The lumbar region is the one usually chosen for puncture because in that location there is no danger of injury to the cord proper. The site usually chosen for the puncture is the third or fourth lumbar interspace, located by drawing a line from the crests of the iliac bones across the spine. The spinal cord becomes the filum terminale opposite the level of the first lumbar vertebra.

The technic of performing spinal puncture is described in detail by Christopher,[2] Labat,[3] and Wechsler,[4] and is omitted here. The diagnostic and therapeutic uses of spinal puncture, the contraindications and the complications will be reviewed in this article.

DIAGNOSTIC PUNCTURE

When a spinal puncture is performed for diagnostic purposes, a manometric study of the cerebrospinal fluid should be done before fluid escapes or is withdrawn. This is one of the most important procedures in the study of spinal cord diseases or injury involving the cerebrospinal system. To be of value the test must be carefully performed and the period of compression and manometric readings must be recorded in detail. The recumbent position is preferred. In this position the normal range of pressure is 60 to 180 mm. of water. In the sitting position, pressure values range from 200 to 250 mm. of water. There is a normal oscillation of 2 to 5 mm. of water with each heart beat, and a 4 to 10 mm. change in pressure with each respiration.[5] Straining and coughing elevate the intraspinal pressure. A water manometer is preferable to one of the mercury type because it is much more sensitive to slight changes in pressure and is much easier to sterilize. The normal oscillations concomitant with the heart beat and respirations give assurance that the point of the needle is not blocked. The initial reading should not be recorded until the patient is relaxed. In the recumbent position, a pressure of 180 to 200 mm. of water is probably abnormal and over 200 mm. is considered definitely abnormal.[5]

The Queckenstedt test is done by compressing digitally both jugular veins for ten seconds and recording the manometer reading every five seconds. If there is no block in the spinal canal, the pressure should go up to 300 mm. of water or above in ten seconds, and should drop back to normal within ten seconds after release of the jugular compression. If there is a complete block in the canal between the needle and the brain, there will be no change in pressure readings. A partial block will give only a slight rise; however, it is often necessary to do combined lumbar and cisternal punctures to demonstrate clearly a partial block. The Queckenstedt test depends on the prevention of flow of blood from the

cranium by pressure on the jugular veins. This causes a rise in intracranial pressure which in turn increases the pressure in the spinal canal.

In the presence of lateral sinus thrombosis or of jugular vein thrombosis, digital compression of the jugular vein on the involved side causes no change in intraspinal pressure, whereas compression of the opposite jugular vein causes a rise. The diagnostic significance of these findings is obvious.

After manometric studies have been completed, about 3 cc. of fluid should be collected in each of three sterile test tubes for the examinations to be discussed. Normally, the fluid escapes drop by drop, but if it is under increased pressure it may come out in a steady stream. Since the type of flow depends not only on the intraspinal pressure but also on the bore and patency of the needle, it is obvious that estimation of the intraspinal pressure by counting the number of drops per minute or from the velocity of flow is subject to many errors.

The normal cerebrospinal fluid is a clear, colorless, slightly alkaline liquid which does not coagulate spontaneously. Its specific gravity is 1.006 to 1.008. It contains sodium chloride (720 to 750 mg. per cent), a trace of albumin (25 to 50 mg. per cent), urea (20 to 50 mg. per cent), and glucose (50 to 60 mg. per cent). Normal cerebrospinal fluid contains few or no cells.

A complete study of the cerebrospinal fluid includes examination of its physical properties, chemical composition and bacterial content, determination of the number and character of cells present and performance of certain serologic tests. The clinician should interpret the gross findings and should make a cell count and a stained smear, but further examination should be done by a competent serologist.

If the cerebrospinal fluid is clear, it does not follow that it is normal, as the fluid may be clear in syphilis, epidemic encephalitis and early tuberculous meningitis. Generally, however, abnormal fluid presents changes varying from a slight cloudiness to actual purulency or shows flocculation. The faintest discoloration or the least turbidity in spinal fluid is significant. To detect such changes the fluid may be compared by daylight with tap water in a similar test tube.

Gross blood in the spinal fluid may be due to (1) trauma to the meninges during puncture or to accidental puncture of a vein, or (2) hemorrhage into the cerebrospinal fluid from disease of or trauma to the meninges of the brain, spinal cord or cerebral ventricles. Fresh blood from trauma incident to puncture is generally not well mixed with the fluid and when the specimen is centrifuged the supernatant fluid is fairly clear. Blood from higher up in the system generally is well mixed. Xanthochromia may be the only evidence of an old hemorrhage. Blood interferes with chemical and cytologic examination. If the blood is incident to puncture and the fluid does not come clear after a few drops, a puncture should be done in a higher interspace or the procedure should be repeated in a few days.

Xanthochromia does not necessarily indicate hemorrhage. A yellow colored fluid is often found below the level of compression of the cord produced by tumors, tuberculosis, syphilis or bone disease. There are two syndromes described that are significant of cord compression. The syndrome of Froin is the presence of xanthochromic spinal fluid that clots spontaneously but has a normal cell count. The syndrome of Nonne is the presence of spinal fluid with an increase of protein but an absence of pleocytosis.

Cytologic study is an important part of examination of the cerebrospinal fluid. Cell counts are done with a counting chamber, as in the method used for blood count determinations. In syphilis, tuberculosis, epidemic encephalitis and late in acute anterior poliomyelitis there is a pleocytosis with predominance of lymphocytes. In meningococcal meningitis and other meningitides due to pyogenic organisms, pleocytosis is present with a predominance of polymorphonoclear leucocytes. The total number of cells is an index to the severity

of the meningeal reaction. Tumor cells may be found in the sediment of the spinal fluid in the presence of a malignant neoplasm of the meninges.

Any sediment should be stained with methylene blue and studied for the presence of organisms. Culture or guinea pig inoculation should be done by a competent pathologist.

Chemical analyses may be helpful in diagnostic problems. An increase in the protein content of the cerebrospinal fluid indicates meningitis. Glucose concentration is diminished or absent in tuberculosis and pyogenic meningitis. Glucose concentration is increased in epidemic encephalitis. Urea is increased in uremia. These examinations, as well as the Wassermann reaction, colloidal gold test and mastic test, are procedures best done in a well equipped laboratory.

Aside from the pressure and fluid studies mentioned above, spinal puncture is used for two other important diagnostic procedures: (1) The injection of air into the lumbar canal as a contrast medium in roentgenographic study of the cerebrospinal system. This procedure was introduced by Dandy[6] in 1919 for the study of tumors of the nervous system. He considers it dangerous in the presence of brain tumors and prefers the injection of air directly into the ventricles for such studies (ventriculography). (2) The injection of radiopaque solutions into the subarachnoid space for roentgenographic studies of the central nervous system. Iodized oils and thorotrast have been used, but thorotrast has been generally discontinued because it was found unsafe. Iodized oils should be used with caution as they, too, are irritants, are not absorbed and cannot be removed entirely from the subarachnoid space.

THERAPEUTIC SPINAL PUNCTURE

Spinal puncture is frequently used for therapeutic purposes, some of which are listed below:

1. Production of spinal anesthesia.
2. Relief of increased intracranial pressure in:
   - (*a*) Head injuries
   - (*b*) Coma due to sunstroke
   - (*c*) Electric shock
   - (*d*) Uremia with convulsions
   - (*e*) Delirium tremens due to alcoholism
   - (*f*) Hydrocephalus
3. Introduction of antimeningococcus serum in epidemic meningitis.
4. Introduction of antitetanic serum.
5. Introduction of salvarsanized serum.
6. Introduction of magnesium sulfate in tetanus.

CONTRAINDICATIONS

Spinal puncture is dangerous in the presence of a marked increase of intracranial pressure, as sudden release may cause compression of the medulla. If the history or physical examination suggests increase in intracranial pressure, or if the optic discs are choked, it is safer not to do a spinal puncture. If one is necessary, extreme caution should be exercised and only a small quantity of fluid should be removed from the spinal canal. Posterior fossa tumors are considered more dangerous than supratentorial tumors, as the cerebellum may herniate into the foramen magnum and compress the medulla.

COMPLICATIONS

Although death directly attributable to spinal puncture is infrequent, as is evident in the report of Wieder[7] of one death in thirteen thousand patients subjected to spinal puncture, the procedure should never be taken too lightly. Sudden release of a markedly increased intracranial pressure may force the medulla into the foramen magnum and cause instant death.

The most frequent but usually least serious complication is the postpuncture headache. This has been considered a "hypotensive" headache and is believed to be due to leakage of fluid through the rent in the arachnoid and the dura. It can be guarded against by using the smallest needle

possible with a short tapered point (Pitkin).[8] Nelson[9] suggested that to prevent leakage a piece of sterile catgut be introduced through the needle and left in place to plug the hole, but this has not been generally adopted. The following discussion of J. E. Moore and his associates[10] covers the more important points in the management of spinal puncture headaches:

"Puncture headache may be prevented in practically every patient by performing the puncture with the patient in the recumbent position in bed, and by keeping him flat in bed in a horizontal position for 48 hours afterward. This necessitates the use of a bedpan and of someone to assist the patient at mealtimes. He should be warned against sitting up.

"If the puncture is done in the office or clinic the patient should be sent home to bed at once, with instructions to remain there, as above advised, for 48 hours. Under these conditions a few patients will develop headaches even when a needle of very small caliber is used. Puncture headache is characterized by its great severity while the patient is in the erect posture, and by its prompt and usually complete disappearance as soon as he lies down. It is sometimes, though infrequently, associated with nausea and vomiting. If a headache occurs, the patient should be reassured, sent to bed for an additional 3 or 4 days, and instructed to drink a great deal of water. The headache is difficult to control with drugs if the patient insists on being up. It commonly lasts 3 or 4 days, but may persist for 2 weeks. It is not serious."

Pease[11] called attention to the possibility of introducing the needle too far and injuring the intervertebral disc. Milward and Grout[12] reported five instances of damage to an intervertebral joint following lumbar puncture.

In the presence of a cord tumor, spinal puncture may be followed by sudden and marked increase of symptoms. This is an important diagnostic point. The segmental level may also become more definite.

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USE OF LOCAL ANESTHESIA IN MINOR LACERATIONS

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THE first duty of a surgeon called to treat a patient with a minor laceration is to determine the extent of the injury. This decided upon he is responsible for treating that wound in a way which will first safeguard the life of the patient, second, give the best functional result possible, and third, be carried out with a minimal amount of suffering to the patient. It is with this last in mind that the present paper has been prepared.

The present series of private patients was begun in 1934, with emphasis on the fact that the procedure was utilized in minor lacerations only, namely, those in which the skin and subcutaneous tissue had been divided, and an occasional instance where a muscle or superficial tendon had been severed. It was not used in those wounds grossly soiled and embedded with dirt.

PROCEDURE

After determining the nature and extent of the injury, any hair about the wound was removed by shaving. The skin of the surrounding area was then cleaned with green soap and water, care being taken not to permit the soap to enter the raw laceration. The wound was flushed with sterile physiologic saline. The surgeon scrubbed his own hands and forearms in the usual manner for about five minutes, completing this by immersing them in alcohol for one minute. In the past three years sterile rubber gloves have been worn, while in the first two years they were not considered necessary (no difference in results has been noted). Inasmuch as all of these patients were treated in an accident room where ungowned or unmasked attendants are constantly entering, no gown or mask was worn.

The area about the wound was prepared by applying some antiseptic. In the earlier cases Scott's solution was used. It, however, had the disadvantage of causing pain if it entered the raw area. In subsequent cases kalmeride was employed but was found to have the same disagreeable effect. This was discarded in favor of 2 per cent aqueous solution of mercurochrome which could be placed in the laceration itself without discomfort; this in turn, because of its red stain, has been succeeded by 1:1000 aqueous solution of merthiolate which is colorless and can be applied to the raw surface as well as the surrounding intact skin without discomfort. No difference between these antiseptics was noted as far as concerned the healing of the wound or the prevention of infection.

The area was then draped with sterile towels in the usual manner. The wound was inspected carefully for foreign bodies which, if present, were removed, along with any blood clots which remained.

The local anesthetic was then applied in the following manner: 1 per cent procaine hydrochloride was injected subcutaneously by means of a 2 or 5 cc. Luer syringe fitted with a small hypodermic needle. The needle point was inserted just beneath the cut edge of the skin (Fig. 1) entering through the raw surface and the subcutaneous tissue infiltrated. The insertion of the needle in this fashion caused apparently no pain and the injection of the fluid was followed by immediate anesthesia. The entire circumference of the wound was infiltrated in this manner. If the wound edges were badly contused so as to appear doubtfully viable or were soiled by some substance difficult to remove, as grease, they were painlessly excised with a sharp knife. The sutures could then be placed at leisure with no pain or discomfort to the patient and without destroying the confidence of very young children.

Lacerations of the face, neck, shoulders or other visible areas were repaired with horsehair, using an end-on mattress suture popularized in this locality by Dr. J. S. Davis.[5] The scalp and perineum were stitched with silk by means of the usual Lembert suture. In a few instances buried ligatures or sutures were necessary and they were of plain No. 0 catgut. In some wounds with marked overhanging of large flaps and large dead spaces a drain was inserted and removed at the end of forty-eight hours. Stitches were removed from the face in four to five days from the scalp and from the back in six to seven days. Where the laceration extended across a joint, as the interphalangeal joint of a finger, that joint was immobilized with a splint.

In previous years the dressing usually consisted of dry gauze, recently, however, xeroform gauze was applied immediately over the wound with dry gauze superimposed upon it. This is believed to be of value, particularly in hot weather, inasmuch as the greasy ointment serves as a protection to the wound against outside contamination from perspiration, while it is not a rigid enough seal to retain pus under pressure should infection occur. Wounds of the lip, nostril and canthus of the eye, where a dressing is difficult to apply and contaminating secretions are present, were dressed by the direct application of compound tincture of benzoin evaporated to a sticky consistency. When exposed to the air this dried quite rapidly, forming a waterproof seal to the suture line. It was easily removed when the time arrived for a change of dressing by applying vaseline to the area twenty-four hours before the appointment and on arrival the benzoin had changed from a hard to a soft consistency and could be picked off with forceps without difficulty.

DISADVANTAGES

The most serious objection is a theoretical one, namely, that the needle is entering uncontaminated tissue through a potentially contaminated field and in this manner might carry some bacteria upon its surface which would be disseminated by the infiltration. The theory presented is reasonable but no supporting evidence, clinical or experimental, could be found either in the literature or by word of mouth.

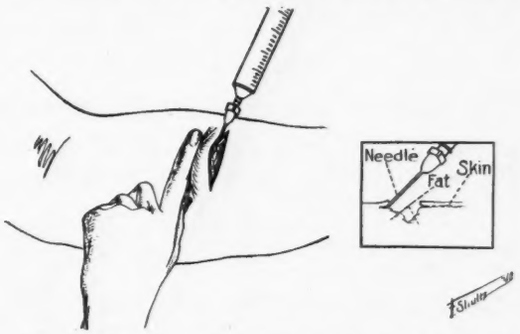

Fig. 1. Diagram illustrating the insertion of the needle point through the cut edge and just beneath the skin into the subcutaneous tissue.

The second objection is likewise theoretical, namely, that the use of infiltrative anesthesia retards the healing of wounds due to the presence of ischemia and the increased liability to infection. No clinical or experimental support of this was found and indeed Gwathmey[4] states that "healing is in no way hindered" by local anesthesia.

Griswold,[1] in 1938, states that if local anesthesia is utilized in fresh wounds it should be injected through the surface of the intact skin, but gives no reasons or supporting evidence.

Christopher[2] states that the use of local anesthesia in open wounds should be more generally employed and that its omission is generally due either to the unpreparedness or the laziness of the physician. He advises injecting the anesthetic into the skin at the margins of the wound but the illustration shows the needle penetrating the unbroken skin surface.

Hertzler[3] states that "usually in emergency work a linear injury to the soft parts is sutured without formality. The sensibilities of the patient, however, can be spared by infiltrating endermically an elliptical line about the wound with novocaine."

The other authorities on surgery, minor surgery, traumatic surgery and anesthesia, who were consulted, did not mention the use of local anesthesia for minor lacerations.

RESULTS

This method was used in 255 cases involving 372 separate lacerations in various parts of the body. Seventeen of these patients did not return for the removal of sutures or other follow-up and, therefore, were discarded. Of the remaining 238 patients with 355 wounds, all healed without infection except seven, an incidence of 1.9 per cent. Of the clean cases, 321 patients were discharged well within one week, ten at the end of ten days and three after two weeks. The exact time of healing of the remaining sixteen is not mentioned due to the fact that there were other injuries upon which more emphasis was placed.

TABLE I

Location	No. of Cases	Infections	No Follow-up
Forehead	71	0	3
Scalp	48	0	1
Fingers	39	4	2
Lip	24	1	3
Chin	23	0	0
Leg	22	1	2
Face	21	0	0
Hand	18	0	2
Nose	17	0	0
Forearm	16	0	2
Eyelid	16	0	0
Elbow	11	0	0
Knee	10	1	0
Ear	7	0	1
Upper arm	7	0	0
Thigh	6	0	0
Perineum	5	0	0
Back	4	0	1
Foot	2	0	0
Toe	1	0	0
Buttock	1	0	0
Penis	1	0	0
Axilla	1	0	0
Abdomen	1	0	0
Total	372	7	17

In five cases there were sloughs due to a questionable blood supply to the flaps at the time of suturing. These five patients were under treatment for six weeks, eighteen days, three weeks, two weeks and two and one-half weeks, respectively. Any case with even the most superficial and minor infection was classified as such.

TABLE II

Ages in Years	No. of Cases
0–5 (youngest 17 months)	14
5–10	28
10–20	40
20–30	56
30–40	45
40–50	21
50–60	16
60–70	10
70–80 (oldest 77 years)	4
Not known	21
Total	255

Of the seven infected patients four infections occurred in wounds of the fingers when the patients, against advice, continued manual labor under dirty circumstances, soiling the dressings and immersing their hands in water. One of these developed a thenar abscess which subsequently had to be opened, thus prolonging treatment for four weeks. In another, removal of the sutures provided adequate drainage and he was discharged in two weeks. One laceration of the knee became infected and required four weeks for healing, while another laceration of the lower leg likewise infected required three and one-half weeks of treatment. The seventh, a lacerated lip, healed promptly in one week. In no case was the infection severe enough to endanger the life of the patient or to require hospitalization for its treatment. The anatomic distribution of the injuries is tabulated in Table I.

No difference was noted in the appearance of the scar as compared to those cases in which other injuries made a general anesthetic necessary for their treatment as well as the suturing of the wound.

ADVANTAGES OF THE PROCEDURE

The prime advantage of this method of treating minor lacerations is that it renders the treatment painless. This is believed to

be a valuable asset and indirectly may cause even further benefits. Thus sutures could be placed leisurely and exactly as desired without being malplaced due to the wincing of an adult or the struggles of a child. Furthermore, the wound could be more carefully inspected for the presence of foreign bodies, unhindered by the above movements. Again, many children, whose confidence in the surgeon was not shattered by a painful procedure, permitted the repair of their wounds in this fashion; whereas a general anesthetic with its greater risk as well as expense would have been necessary. This is illustrated in Table II which shows that fourteen of the above patients were less than 5 years of age, the youngest being 17 months, while an additional twenty-eight were between 5 and 10, ages wherein cooperation would often be impossible for a painful procedure. The oldest patient was 77.

TABLE III

Cause of Injury	No. of Cases
Automobile	117
Bumping against unseen object	29
Fall	24
Glass or tin	24
Sharp instrument	18
Athletics	18
Machinery	10
Struck by stone	4
Fight	3
Kicked by horse	2
Dog bite	2
Epilepsy	1
Not known	3
Total	255

Furthermore, the method is simple, requires no special apparatus or assistance and is applicable to office as well as hospital practice.

COMMENT

The writer hesitated before presenting such a minor subject and had some qualms about advocating a procedure which has had the disapproval of at least some authorities. Furthermore, he is well aware of the theoretical soundness of the objections voiced. With no objective evidence against the procedure, while actual experience in 355 wounds has given what is believed to be a satisfactory result, it is the author's conviction that the practical advantages have outweighed the theoretical danger. However, it should be utilized only in selected cases, eliminating the grossly dirty, badly contused wounds and restricting its use to those lacerations which are linear in type and relatively clean.

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PARALDEHYDE: A BASAL ANESTHETIC FOR TONSILLECTOMY IN CHILDREN

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THE importance of preoperative sedation is almost universally accepted. There is, however, no unanimity as to drug or dosage. Paraldehyde by rectal instillation has been used for this purpose for many years, almost all of the published literature emanating from abroad. Reports from Great Britain and her colonies have been most enthusiastic. Claims have been made that this method of sedation is (a) safe for both children and adults; (b) rapid and certain in action; (c) safe for use in "bad risk" patients, such as decompensated cardiacs, cachectics, and chronic nephritics; (d) offering complete amnesia with a refreshing sleep.[1–10]

In addition, the statement is repeatedly made that there is no effect upon either circulatory or respiratory system, almost all of the drug being eliminated unchanged through the lungs, the remainder through the kidneys.

Impressed with the valuable properties ascribed to paraldehyde by rectum, and especially the favorable report of Sourasky[11] on its use as a preliminary to tonsillectomy in children, we have been giving paraldehyde by rectum routinely since 1937 as a premedication for tonsillectomy to all children on Otolaryngological Ward Service Number Three at the Jewish Hospital. The following technique has been used.

The patient is given a simple enema the morning of operation. One hour preoperatively he receives a retention enema of paraldehyde. In the first series of 104 consecutive cases, this was used in the proportion of 1 c.c. for every 5 pounds of body weight. In the second series of 117 consecutive cases, the ratio was changed to 1:8. In several unselected cases this was further reduced to 1:10. The largest dose ever used was 20 c.c. in a 12 year old child.

The paraldehyde is usually mixed by simple agitation with an equal volume of tap water and given with a soft rubber catheter and syringe at room temperature. Occasionally mineral oil is substituted for the water. The enema is easily retained by all but the youngest children who sometimes do not coöperate. Within fifteen minutes, patients fall into a sound sleep that resembles normal slumber. Although they can be aroused, they are somewhat confused and fall off to sleep again. Preoperative restlessness and excitement are not observed nor are there any other untoward symptoms.

All the children in our series took anesthesia well (invariably open drop ether). After the operation, they continued to sleep for four or five hours, a slumber that was peaceful and much longer than that usually seen. If vomiting occurred, they awoke for a short spell and then promptly returned to sleep. Drowsiness was observed for about twelve hours. There was no hangover, proctitis, or other unpleasant sequela. The pharyngeal reflexes were not interfered with during operation.

As a control, the records of a number of routine tonsillectomies performed on the same service just prior to 1937 without benefit of any premedication were reviewed. Postoperative vomiting in the paraldehyde group was diminished both in extent and in the number of patients affected, occurring in 43.3 per cent of patients receiving paraldehyde in the 1:5 ratio, 50.4 per cent of those receiving it in the 1:8 ratio and 63.3 per cent of the controls.

Postoperative resuturing for profuse bleeding was required in two of the paraldehyde and two of the control series. In all four instances, the additional suturing was required about five to twelve hours after the operation. There was nothing to suggest more bleeding or capillary oozing in those patients under paraldehyde narcosis.

Table I
NUMBER OF CASES BY AGES

Dose	Age											Total
	2	3	4	5	6	7	8	9	10	11	12	
1:5	11	8	11	10	22	12	10	8	4	4	4	104
1:8	6	12	18	16	24	10	13	6	3	7	2	117
1:10					1	1	1					3
Total	17	20	29	26	47	23	24	14	7	11	6	224
Controls	29	57	46	54	52	44	29	23	22	12	16	384

The nursing staff did not find the administration of the sedation an involved procedure. On the contrary, they were most enthusiastic because of the smooth postoperative convalescence. The higher dosage was considered more effective and more satisfactory. The unpleasant odor of paraldehyde was not a factor of any importance in this study in that it was not perceptible to anyone postoperatively and was never even noticed by the patient. On questioning, many of the older children acknowledged complete amnesia of recent events, some of them asking when the tonsillectomy was going to be performed.

Table II
NUMBER OF CASES OF POSTOPERATIVE VOMITING

	Age											Total	Percentage
	2	3	4	5	6	7	8	9	10	11	12		
Paraldehyde cases	7	8	18	15	21	11	14	5	3	5	0	107	47.8
Controls	11	35	28	32	41	33	16	14	16	9	8	243	63.3

The wide margin of safety present with paraldehyde is illustrated by the following case report presented here through the courtesy of the attending surgeon.*

R. Z., a white male child, 9 years old, was admitted to the Jewish Hospital with a diagnosis of acute appendicitis. His temperature, pulse and respirations were 100°F., 110 and 22 respectively. He was to have received 2 drachms of paraldehyde mixed with 1 ounce of water as a retention enema, but was inadvertently given 2 ounces of paraldehyde. Within fifteen minutes, the patient lapsed into unconsciousness with shallow breathing, pin-point pupils and some cyanosis. The error in dosage was noted immediately and a mixture of oxygen-carbon dioxide administered. One-half hour later, the patient's condition being considered good, operation was performed without additional anesthesia and a gangrenous appendix removed without drainage. At this time, the pulse reached a high of 160 per minute with a respiratory rate of 44 per minute. The temperature rose to 101°F. (All temperatures are rectal.) A continuous intravenous infusion of 10 per cent glucose in normal salt solution was begun although there were no alarming signs. Gradual return of consciousness began, followed by complete recovery about twelve hours after the administration of the drug. Convalescence thereafter was entirely uneventful. Urinalyses were entirely negative throughout.

Table III

Paraldehyde Dose	No. of Cases	Average Pulse Rate		Postoperative	
		Before Operation	After Operation	Abdominal Pain	Earache
1:5	104	102.4	113.7		
1:8	117	100.8	108.6		
1:10	3				
Total	224	.....	.....	2	0
Controls	384	101.5	111.0	3	4

Hanson[12] described a case in which 4 ounces of paraldehyde were given by rec-

* From the surgical service of Dr. N. Rothschild.

tum in a single dose to a woman in labor instead of the desired 4 drachms. The patient made a complete recovery and renal activity was at no time affected.

Walker[13] had a similiar experience, the dose given being 2 ounces each of paraldehyde and ether. There were no sequelae.

The entire subject of paraldehyde poisoning has been reviewed by Kotz, Roth and Ryon,[14] who concluded that paraldehyde is a relatively safe and effective analgesic agent and that fatal poisoning with it is rare despite frequent overdosage.

SUMMARY

Paraldehyde was used as a preoperative sedative for tonsillectomy in children in 224 cases. Best results were obtained using 1 c.c. of paraldehyde for every 5 pounds of body weight, mixed with an equal volume of tap water as a retention enema. The results were highly gratifying, the method simple and safe, the cost insignificant. No untoward reactions were observed.

A case of accidental administration of 60 c.c. of paraldehyde by rectum to a 9 year old child, with uneventful recovery, is reported.

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INFECTIONS OF THE TENDON SHEATHS

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INFECTIOUS tenosynovitis is best illustrated in the hand and forearm for we find these sites most frequently involved. This type of infection is always a serious one and may result in complete loss of function of the involved digit together with considerable stiffening of the hand. While the offending organisms are usually the streptococcus or staphylococcus, other organisms may affect the tendon sheaths.

From a clinical point of view the sheaths upon the flexor surface of the hand are the most important. Figure 1 illustrates the location of the various sheaths and the incisions necessary to give adequate drainage. On the dorsum of the hand the sheaths are less extensive but the infection here can also rupture into the adjacent fascial spaces of the palm.

With the organisms of streptococcus and staphylococcus the infection is commonly an acute one and the viability of the tendon is always threatened if the patient is not treated promptly.

A puncture wound in the pulp of the finger may cause a local infection and easily extend across the thin membrane constituting the terminus of the flexor tendon sheath. The streptococcic infection may spread up into the finger or hand in only a few hours; and while the staphylococcus spreads more slowly, local distention of the tissues with exquisite pain and tenderness is the rule. Kanavel has shown conclusively the pathway these infections of the hand follow. He has stressed that one must be familiar with the essential anatomy of the hand to appreciate and prevent dangerous complications from infections of the tendon sheath.

Following involvement of the tendon, there may be separation with the final death and destruction of the tendon. Usually the patient will remember the entrance of some foreign body into the hand or a puncture of the finger, and all of these penetrating wounds are particularly dangerous if located over the flexor creases of the fingers or thumb. At this point the sheath lies close to the skin, and is not protected by the pad of fat found over the shaft of the phalanx. Infection may also start by direct extension of a nearby infection and the finger will quickly assume the semiflexed attitude. Exquisite tenderness will be found along the sheath throughout its entire course. Immediate operation should be done to relieve the tension before there is necrosis of the tendon; and if the infection lies within the tendon sheath itself, it must be quickly opened and every effort made to give adequate drainage. Incisions, therefore, must be made as outlined, placing them on the side of the finger toward the dorsum and not on the flexor surface. The incision by being placed on the side will prevent any tendency to bowing of the underlying tendon and the resultant scar will give a minimum of functional disability. The vessels and nerves will be avoided by placing the incision toward the dorsum of the finger as shown in the diagram and adequate drainage of the sheath will be provided. Care should be taken to retain bridges of the tendon sheath opposite each joint as shown by the diagram and the skin wound should be loosely packed—*not the tendon sheath*. Care should also be taken not to lift or disturb the tendon sheath from its bed. Following this emergency surgery, a 1/1000 solution of acroflavine and glycerin or sterile paraffin oil may be used to prevent the packing from adhering to the surrounding tissues and yet permit free drainage. This dressing can

be easily changed with a minimum amount of discomfort to the patient, but it need not be changed more than once a day. If this technic is employed, hot compresses and hot sand bags can be discontinued except for the first few days of the inflammatory reaction. It is well to splint the fingers but to allow motion early, so the time of splinting can be cut as short as possible. Couch advises that the hand be laid on a pillow with the palm upward or carried in a sling as it will fall into a much better functional position than if it is permitted to rest palm downward. This latter position may give rise to a rather useless type of "flat hand." Active movement of these infected hands should be started as soon as the patient comes out of the anesthetic; and if one is dealing with a cooperative patient, later results will repay him for his initial pain and discomfort on forced movement.

When the dorsal synovial sheaths are infected, splitting of the sheath throughout its course apparently gives the best results, but this locality is much less frequently affected than the palmar sheaths and the danger of the fascial spaces being involved is also less.

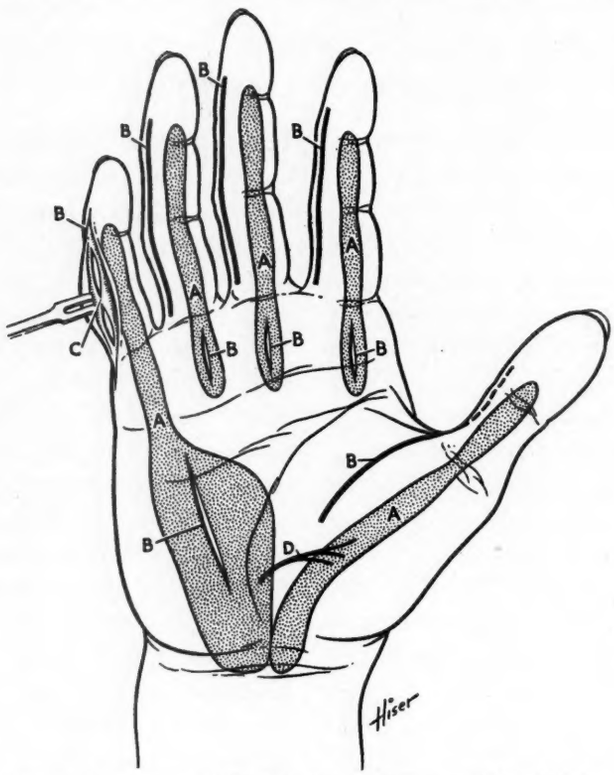

FIG. 1. *A*, anatomic distribution of flexor tendon sheaths. *B*, elective skin incisions for draining tendon sheath infections. On fingers incisions should be posteromedial or posterolateral. *C*, illustrating how island of tendon sheath should be preserved at flexion creases. *D*, incisions should not be prolonged to injure branches of ulna nerve.

The treatment pursued in the first few days following the incision and drainage is very important. It is a good plan to immerse the patient's hand and forearm in hot sterile water while the surgeon gently and passively moves and extends the fingers and wrist several times each day. This early, gentle manipulation will encourage the patient to move the involved tendon sheaths.

Sulfanilamide is routinely used in all the streptococcic, staphylococcic and gonococcic infections involving tendon sheaths.

Gonococcic tenosynovitis can be established by the history of a recent urethritis

and finding of the organism on smear. It is not as common a complication of gonorrhea as a transient multiple arthritis, but when found is best treated by local rest to the part and chemotherapy.

Syphilis involving the tendon sheaths is occasionally seen but is not a rapidly fulminating process, although it may be a manifestation of the disease in its early stage. It yields most satisfactorily to antiluetic treatment.

Another form of sheath infection is caused by the tubercle bacillus. It is most commonly found involving the flexors and extensors of the wrist, but it may be found in the tendon sheaths about the ankle. It is characterized by a leathery crepitation which can be felt and sometimes heard if the tendons actively move. It is a chronic process and on opening the sheaths a varying number of "rice bodies" may fall out of the wound. Treatment consists in evacuating these "rice bodies" and in making as complete an excision of all the infected tissue as possible. Excision of the tendon sheaths in these cases is tedious but offers the best chance of cure. A more conservative method advised may consist in introducing 5 per cent iodoform in glycerin into the tendon sheaths followed by a long period of immobilization.

SUMMARY

Acute infections of the tendon sheaths most frequently involve the fingers and hand, and due to the anatomic arrangement of these sheaths rapid spread of the infection may be expected.

Early adequate surgery along the areas of election shown in the diagram offer the best opportunity for the return of function.

INFECTION OF FASCIAL SPACES OF THE PALM*

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THERE are two constant, well defined fascial spaces in the palm. These spaces lie deep to the flexor tendons and their sheaths and to the digital nerves and vessels. It is important that the surgeon who makes incisions for drainage of infection in this region have a knowledge of the anatomy of the hand.

The middle palmar space lies between the flexor tendons and lumbricales anteriorly and the fascia covering the interosseus muscles behind. Medially the space is limited by the attachment of the palmar fascia to the fifth metacarpal. The thenar space lies chiefly between the palmar fascia in front and the adductor pollicis behind. The flexor tendons and lumbrical muscle of the index finger are anterior to the medial portion of the thenar space. Laterally the space is limited by the radial bursa. These two spaces are separated from each other by a fibrous septum extending from the palmar fascia backward to the third metacarpal. They extend distally to a line drawn from the ulnar end of the distal flexion crease of the palm to the radial end of the proximal flexion crease. Proximally they extend to about an inch below the distal flexion crease of the wrist. These spaces send projections along each finger to enclose the lumbrical muscles and the digital nerves and vessels. The lumbrical canal of the index finger enters the thenar space. The canals from the three medial fingers enter the middle palmar space. (Fig. 1.)

Fascial space abscesses occur after local implantation of pyogenic organisms. The injury responsible for the development of a hand infection may be anything from an apparently trivial prick with a pin or splinter to an extensive laceration or contusion. The organism is usually a Streptococcus or Staphylococcus aureus.

Infections of the fascial spaces of the palm are more often secondary to other infection in the hand than primary from direct injury. Infection may enter by extension down the lumbrical canals either from subcutaneous infection in a finger or after rupture of an infected flexor tendon sheath at its proximal end. Either the radial or the ulnar bursa may rupture into the adjacent fascial space. Infection in the middle palmar space is usually from the middle, ring or little finger. Infection in the thenar space comes from the thumb or the index finger.

The symptoms of palmar space abscesses are those of a severe local inflammation plus a general toxemia. Suppuration in either the middle palmar or the thenar space results in a swelling of the entire hand. The swelling over the back of the hand is usually great, but it is a pitting edema rather than the brawny induration seen on the palmar surface. The fingers and thumb are held in flexion but they can be moved passively with only moderate pain. There is no well localized tenderness and no fluctuation even though the amount of pus present is considerable.

In a middle palmar space infection there is usually a bulging in place of a concavity in the palm. In other types of hand infections the concavity of the palm is often lost but it does not become a convexity. There is tenderness over the entire palm, particularly over the ulnar side. There is pain on moving the third, fourth and fifth fingers. There may be extension of the infection along the lumbical canals of these three fingers. This causes pain, tenderness,

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redness and swelling in the webs between the fingers. Pointing or fluctuation may be present here. The infection sometimes extends between the heads of the metacarpals and points on the dorsum of the web.

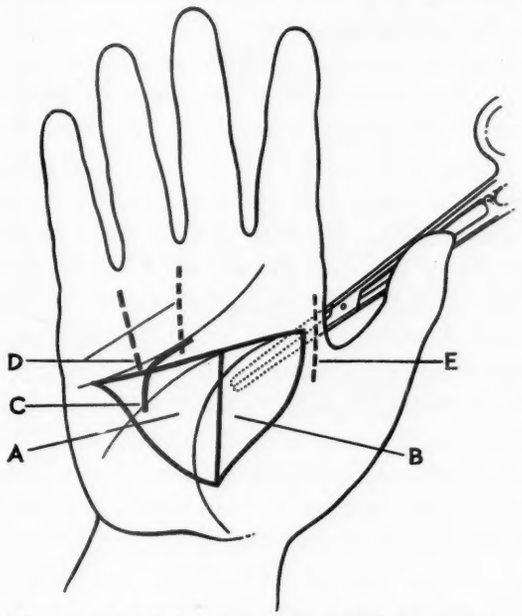

FIG. 1. A, middle palmar space; B, thenar space; C, incision for drainage of middle palmar space; D, incisions for drainage of middle palmar space with extension into the lumbrical canals; E, incision on the back of the hand for drainage of the thenar space.

A thenar space abscess results in an extreme amount of swelling of the thenar eminence. The swelling of the back of the hand is more marked on the radial side. Movements of the thumb and index finger are limited and more painful than movements of the other fingers. The abscess sometimes points in the web between the thumb and index finger.

Involvement of both spaces is more difficult to diagnose. The extreme swelling of the entire hand, the large thenar eminence and the bulging in the palm are the most characteristic findings.

In attempting to make a diagnosis of a possible fascial space abscess the first point to be determined is the site of the original injury. This should be followed by an accurate history of the subsequent course of the infection.

Infection beginning on the thumb may reach the thenar space if it is confined to the subcutaneous tissues. Involvement of the tendon sheath of the flexor pollicis longus will spread the infection through the radial bursa. From here it is more apt to extend to the ulnar bursa and to the forearm than it is to the thenar space.

FIG. 2. Incision for draining thenar space.

Infection extending upward from the index finger may reach the thenar space. This is particularly true if the flexor tendon sheath becomes infected and ruptures at its proximal end. Infection following injury to the tissues of the thenar eminence may reach the thenar space as the palmar fascia is thin over its lateral portion and forms a poor protective barrier.

Infection from the middle and ring fingers, whether or not it involves the tendon sheaths, may reach the middle palmar space. This is also true of subcutaneous infection of the little finger. Infection in the tendon sheath of the little finger will continue along the ulnar bursa and reach the forearm and the radial bursa before involving the fascial spaces of the palm.

Infection implanted directly into the concavity of the palm will not spread through the palmar fascia. If it is placed under the aponeurosis, the infection will extend to the fascial spaces.

Abscesses of the middle palmar and thenar spaces do not extend upward to the forearm. They may point in the webs between the fingers and rupture on the back of this region or they may extend into the radial or ulnar bursas. Evidence of infection above the wrist joint in the presence of fascial space abscesses indicates such an extension to the bursas.

The prognosis of uncomplicated fascial space abscesses promptly recognized and properly treated should be excellent when compared to the end results of hand infections involving tendon sheaths.

TREATMENT

The treatment of infection of the fascial spaces of the palm is incision and drainage as soon as a diagnosis of suppuration in this region can be made. To wait for such an abscess to point or to wait for fluctuation to occur may do irreparable damage by allowing the infection to spread to other structures. To wait until the day after a decision to operate has been made is negligence.

The patient should be in a hospital in order not only to insure a proper operation but also to supervise the postoperative care. A general anesthetic is necessary. The arm is held vertical for at least three minutes to drain the blood from it, then a tourniquet is applied. This may be a blood pressure cuff or a wide rubber band.

The operator should have in mind before he begins just what anatomic structures he intends to expose. He should then proceed with a careful dissection to expose those structures. Skin incisions should be placed in such a manner that they allow adequate drainage, do not endanger important underlying structures and do not result in disabling contractures on healing. The wound edges and the underlying nerves, vessels and tendons or tendon sheaths should be retracted as the operation proceeds to allow a good view of the bottom of the wound at all times. There is no place in the surgery of hand infections for the quick, stabbing incision. If pus enters the wound, it should not be considered a signal that the operation is finished. The pus should be wiped out and the operator should continue until he is certain that all abscess cavities are opened adequately.

The middle palmar space can best be opened by an incision which begins in the interval between the metacarpals of the middle and ring fingers at the distal flexion crease of the palm or just proximal to the crease. From here the incision runs parallel to this crease across the metacarpal of the ring finger, then curves upward and runs parallel to and just in front of the ulnar border of this metarpal as far as the proximal flexion crease. The flexor tendons of the ring finger will be exposed and are to be retracted laterally. The digital vessels and nerve to the ulnar side of the ring finger will be exposed and should be retracted medially. The middle palmar space can then be opened through an incision similar to the skin incision. The ulnar bursa extends as far distally as the proximal flexion crease, therefore, care must be used to avoid injuring the ulnar bursa in the upper end of the wound. This incision allows good drainage of the middle palmar space, does not injure nerves or vessels and does not cross flexion creases with a resultant contracture of the scar. The incision can be extended proximally to open the ulnar bursa when this is also infected.

If the infection extends down along the lumbrical canals, a better incision is one made directly over the infected spaces in the web between the fingers. This extends proximally to just above the distal flexion crease. From here a hemostat can be thrust into the middle palmar space. The incision must not extend across the edge of the web. In this incision as in the one previously described the digital nerve and vessels must be identified and retracted to avoid injuring them. This incision has the disad-

vantage of not giving as good exposure as the other and also it crosses a flexion crease at a right angle with a resultant danger of contracture developing.

Thenar space abscess is drained through the back of the web between the thumb and index finger. (Fig. 2.) With the thumb in a position of opposition the incision is made along the anterior edge of the distal half of the metacarpal of the index finger. A hemostat is inserted into the thenar space and opened widely. The hemostat must not be inserted past the lateral border of the third metacarpal to avoid injuring the fibrous septum between the thenar and middle palmar spaces. In thenar space abscess pus will sometimes lie posterior to the adductor pollicis as well as in the usual position anterior to this muscle. Both locations can be reached through this incision on the back of the web.

When both the thenar and middle palmar spaces are infected, the intervening fibrous septum can be opened by a hemostat thrust through from the lateral side. However, a drain is not inserted through both spaces. There is no place for through-and-through drainage in hand infections.

After the infected fascial space is opened a soft rubber drain is laid into the bottom of the cavity and brought out flat through the wound. A single strip of vaseline gauze can be used in place of the rubber dam. The drains are left in place one or two days. By this time it should be possible to remove them without danger of the wound closing too soon.

A metal splint is incorporated into the bandage after the hand is opened. This will permit proper fixation in the best possible position for function. The metal splint also allows wet dressings to be applied without disturbing the position of the hand. The hand is bandaged with the wrist in moderate extension with slight ulnar deviation; the fingers are partially flexed and are well separated from each other, and the thumb is in a position of opposition.

Warm wet dressings of normal salt solution are usually applied for twenty four hours or more following surgery. They are then continued for one or more hours daily as long as necessary. The wound is dressed daily using aseptic technic to avoid the introduction of secondary infection. At each dressing the hand is examined for evidence of further spread of infection. At the same time an attempt is made to put all the joints of the hand through a full range of motion. As soon as the infection has subsided and the wound is healing more intensive physical therapy is begun. This consists of hot soaks or whirlpool baths, massage, and active and passive exercises. The hand should be kept in a splint part of the day to preserve the position of function until the wound is entirely healed. It may be necessary to continue active exercises and passive stretching for weeks or months to restore full use of the hand.

The pus is cultured at the time of operation and sulfanilamide or related compounds are administered as indicated. General supportive measures are used as in any severe infection.

SUMMARY

1. A knowledge of anatomy is necessary for the proper diagnosis and treatment of infections of the fascial spaces of the palm.

2. Such infections should be considered surgical emergencies and treated promptly.

3. Incisions for drainage of these infections of the hand should be made by careful dissection, with the patient under general anesthesia and with a tourniquet on the arm.

4. The function of the hand after such an infection will depend largely on adequate surgery plus persistent physical therapy.

LUXATED AND SEVERED TENDONS*

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TENDON injuries are important because early recognition and proper diagnosis is indispensable to adequate treatment. By luxation or dislocation of a tendon we imply displacement of the tendon from its normal position. By severence of a tendon we mean a partial or complete interruption of continuity. The unsatisfactory results which generally follow failure to diagnose and properly treat these affections justifies a discussion of the principles of diagnosis and treatment.

LUXATED TENDONS

Displacements or dislocations of tendons is by no means a common finding. The peroneal tendons, however, are more frequently luxated than any other. Either one or both tendons may be involved. A congenitally shallow groove at the external malleolus may be an etiologic factor. In some cases the dislocation may be present at birth, but more frequently it is induced by trauma subsequently.

In a typical case the tendon can be seen and felt to glide forward over the lower end of the fibula as the foot is flexed and slightly everted. Pain is not usually a prominent symptom, the disability being caused by loss of mechanical efficiency of the pull of the tendons. This displacement is often associated with calcaneovalgus deformities of the foot following infantile paralysis.

The type of treatment depends upon whether the case is seen early or late. If the patient is observed soon after the slipping has occurred, the tendons can be replaced. Reduction is maintained by applying a plaster boot cast with the foot at right angles to the leg and slightly everted. Fixation is continued for a period of from four to six weeks, after which function is gradually resumed.

If the displacement has been present for some time or if conservative measures fail, an operation to replace the tendon is indicated. The technic of Ellis Jones[1] is simple and apparently quite efficient. The operation consists of exposing the tendons in their sheaths and replacing them in their proper position. A tongue shaped section of tendo Achillis is dissected downward from its lateral border. The free end is passed through a drill hole in the external malleolus and sutured to itself, forming a sling which prevents redislocation. In paralytic cases associated with a calcaneovalgus foot, correction of the deformity is all that is necessary.

Luxation of Long Head Biceps. Dislocation of the long head of the biceps muscle has been described by Gilcreest[2] and others. But in the experience of the writer it occurs very rarely. The etiology is trauma, either often repeated minute traumas or sudden severe movements of the arm into external rotation and abduction. The symptoms include pain in the region of the bicipital groove which is increased by placing the arm in overhead extension and external rotation. Weakness and disability of the extremity is a common complaint. The diagnosis rests on the symptomatology and proper evaluation of physical findings. There is usually some tenderness over the front of the shoulder in the region of the biceps tendon. Occasionally one is able to palpate the tendon outside the groove or the empty groove itself, which cinches the diagnosis. Unfortunately, these signs cannot be constantly demonstrated because of the presence of overlying structures. Gilcreest has described a test upon which he

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places much emphasis. The patient raises his extended and externally rotated arms over head. A five pound dumbbell is held in each hand. The examiner then places his fingers on the long head of the biceps as the arms are lowered to the side of the body in the coronal plane. When the outstretched arm reaches an angle of 110 to 90 degrees, a snap may be heard and felt in the injured shoulder which is accompanied by acute pain in the shoulder and also in the region of the bicipital groove. Gilcreest considers a positive test pathognomonic of the lesion.

Treatment. If the case is seen soon after the accident, replacement may be accomplished by manipulation; and if successful, the arm is immobilized to the side of the body for two weeks. The indication for surgical treatment rests on the degree of disability present. If the patient is a laboring man who must use his arms in heavy work, early operation is the treatment of choice. The purpose of the operation is to replace the tendon in its groove and hold it there by suture of the transverse humeral ligament. Gilcreest advises cutting the tendon high in the joint and suturing the proximal end into the coracoid process and into the tendon of the short head of the biceps. Following operation, a Velpeau dressing is applied for about two weeks after which function is gradually resumed.

The condition known as snapping hip, while not definitely caused by a luxated tendon, is a somewhat analagous type of disability. In the writer's experience, the incidence of this affection is very uncommon. These cases are characterized by an audible and palpable snap produced by a tight fascial band slipping forward over the trochanter. Frequently the band can be seen to slip forward. The band usually consists of a thickened portion of the iliotibial band or an accessory slip of the gluteus maximus muscle at its insertion. Treatment is not often required because the condition is not usually painful. However, in one of the writer's cases, the patient was aware of a snapping at the hip for several years before pain developed from which she sought relief. When treatment is necessary it is entirely surgical. The operation is best performed under local anesthetic so that the patient can reproduce the snap which makes the band easier to locate. While several different operations have been proposed, apparently all that is necessary is to incise the fascial band transversely below the level of the great trochanter and suture the edges to the periosteum to prevent reunion.

SEVERED TENDONS

Tendons are usually severed by sharp objects such as a knife, glass, tin, or pieces of porcelain from broken water faucets, or they may be severed by severe muscle pull following some untoward movement or violent exercise. The greater number of tendon injuries from incised wounds occur in the upper extremities; whereas, rupture of muscles and tendons seems to occur more frequently in the lower extremities.

The first and most important step in the treatment of any condition in which tendon involvement is obvious or suspected is a careful examination to determine the extent of the injury. The necessity for this seems clear, and yet one not infrequently sees cases later on with evidence of severed tendons which were completely overlooked at the time of accident.

In connection with open or incised wounds the great danger is the distinct possibility of infection. When it occurs the success of the operation is in doubt and the patient's life may be endangered. Obviously, therefore, one should never repair a tendon in the presence of infection or in a grossly contaminated wound in which infection is likely to occur. As a rule a tendon should be sutured as soon as possible following injury, but many factors must be considered in determining whether a primary or delayed suture should be done. Among these are the character and extent of the wound, the nature and extent of the first aid treatment, the length of time which has elapsed since injury occurred, and last but not

least, the skill and surgical judgment of the operator.

If the wound is a cleanly incised one, sustained indoors, with the patient's skin relatively clean, immediate suture may be performed. On the other hand, in grossly contaminated and dirty wounds a delayed suture is the method of choice. As a matter of general principle, wounds which are more than eight hours old should be cleansed as thoroughly as possible and the superficial tissue sutured loosely, and any tendon repair deferred until complete healing has occurred.

The repair of a severed tendon is a major operation, and the surgeon should have at his disposal all the necessary facilities for carrying out the work. We believe that a general anesthetic is preferable to local anesthesia. It goes without saying that the operator must be thoroughly familiar with the anatomy of the part in question. These operations are often long and meticulous procedures, which tax the skill of the surgeon and the endurance of the patient. We also believe that some of the poor results following otherwise adequate surgery are due to pulling apart of the tendons following suture. Too little attention has been paid to the proper physiologic and mechanical methods developed for tendon suture. The reader is referred to the excellent work of Koch,[3] Mason,[4] and others for details of technic.

SUMMARY

1. The more common luxations of tendons have been briefly discussed.

2. Severed tendons are briefly discussed from a general standpoint.

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TREATMENT OF INGROWN TOE NAIL*

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OF all the innumberable ailments to which the human foot falls heir, I know of no condition more aggravating than the common, garden-variety of ingrown toe nail. This occurs, as a rule, on the great toe, either on the inner or outer border of the nail, ranging all of the way from mild irritation by pressure of the nail edge to extensive infection involving the entire toe. Like the popular "athlete's foot," with which it is sometimes associated, ingrown toe nail is placed in the category of conditions expected to be amenable to home treatment. It seems that the patient usually runs the gamut of curbstone advise from his neighbors, shoe fitter or medical friends, with the result that he has tried many measures for relief, most of which are worthless, many of which are definitely harmful and very few of which actually get to the seat of the trouble. A brief description of the condition is in order to clarify the contraindications to the usual bedroom management.

By far, the most common factor in etiology is an increase in convexity of the nail so that the superior surface of the nail, instead of being mildly convex, assumes a definite exaggeration of curvature, particularly at the margin of the nail. This serves to thrust the lateral edge of the nail deep into the perionychial fold (nail fold), and to permit the soft tissue of the toe to roll up over the side of the nail. (Fig. 1C.) This embedded margin of the nail thus presses deeply into the tissue and causes pressure and irritation. As inflammation increases, pressure increases, so that a vicious cycle is established; the more pressure, the more irritation and the farther the nail edge burrows into the tissue. Thus, it is evident that the major aim in treatment must be to flatten the nail in such a way that the lateral margins will not grow under but will project laterally with only a moderate degree of convexity. (Fig. 2D.) This, in brief, is the aim of any treatment, whether it be preventive, conservative or surgical. Any measure which fails in this is likely to result in failure to correct the condition. This, perhaps, represents an oversimplification of the problem, but for the purpose of this discussion is, in my opinion, entirely adequate.

It might be worthwhile to mention a few of the definitely deleterious procedures which are often advised and carried out, before proceeding to give a summary of proper management for the different stages and degrees of this condition. One of the popular corrective measures for this condition is to cut off the corner of the nail which, temporarily, relieves the pressure of the nail margin on the ulcerated perionychium and does give temporary relief from discomfort. As the nail grows back in, however, the curvature usually becomes more pronounced and the condition is only aggravated. Another popular treatment is to remove the toe nail entirely. This, of course, results in the same thing, since the new nail very often grows in smaller and more convex than the original nail. Another method is to split the toe nail, and to remove the lateral or medial edge of the nail which, again, gives temporary relief and permanent aggravation. These measures are to be avoided rather than adopted.

TREATMENT

The proper treatment of ingrown toe nails falls into three classifications: first, preventive; second, conservative; third, surgical.

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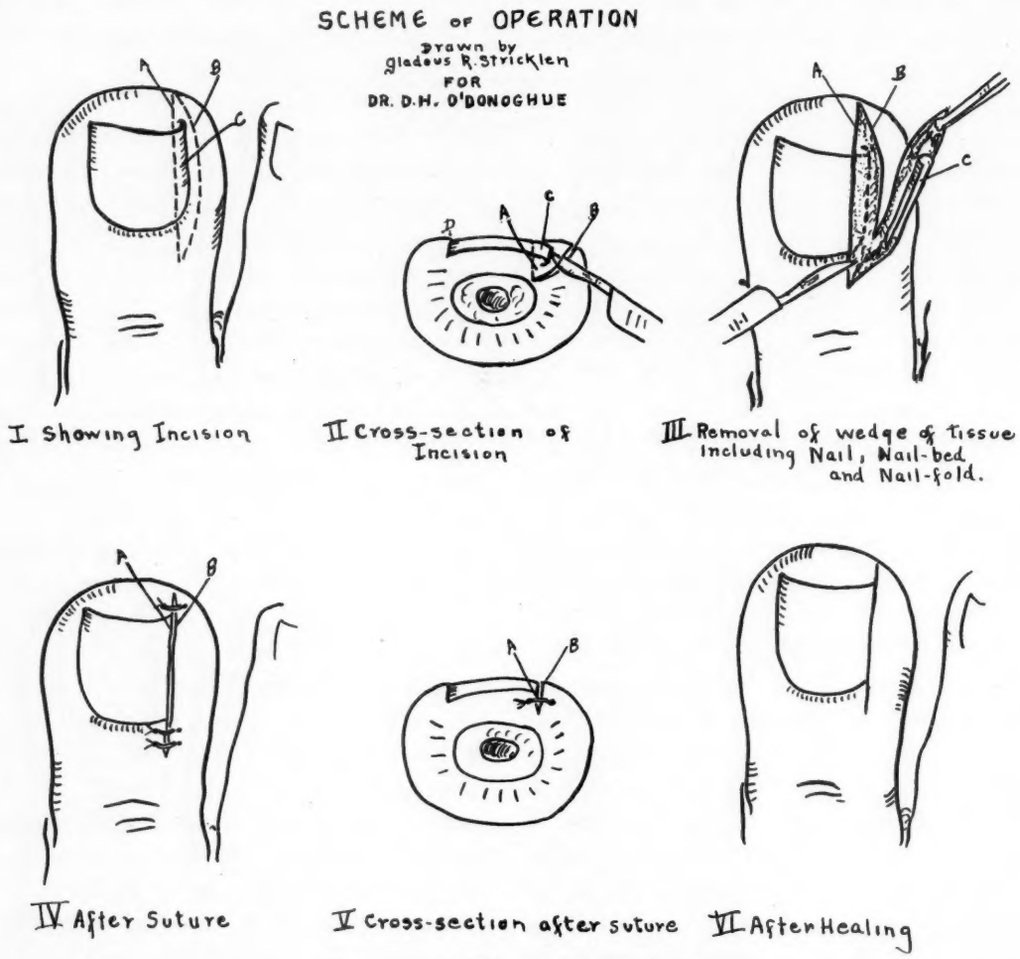
Preventive Treatment. Our essential aim here is to prevent increased convexity of the nail with resulting pressure into the soft tissues of the toe. Anything which tends to press the toe laterally and roll the soft tissue over the edge of the nail will tend to cause an ingrown toe nail. Some of the most common causes for this condition are: a short shoe, which forces the great toe laterally against the second toe; a too narrow shoe which accomplishes the same result in a different way; a short sock or too great lateral deviation of the inner border of the shoe caused by a pointed shoe. Obviously then, the proper means for prevention of ingrown toe nail is to insist on a well-fitted shoe, neither too narrow nor too short, and a comfortably fitted sock which does not force the toes together when the foot is thrust into the shoe. In order to prevent the corner of the nail from curling down, it should be trimmed fairly close but not rounded, thus leaving the corner of the nail always exposed in the soft tissue and not buried. The toe nail should not be rounded as is the finger nail. Any gross disturbance of function of the foot, such as pronation of the forefoot, uneven weight bearing, etc., can result in trouble about the toes by throwing an increased burden of weight on the medial border of the foot so acting to force the soft tissues over the nail margin. Any static inbalance of the foot can be a contributing factor and should be corrected. Proper hygienic care of the foot is, of course, essential, and any cause for irritation about the eponychial tissue should be carefully treated, since any distortion of growth of the nail may result in increased convexity with resulting trouble along the nail margin. If the nail has a tendency to be thick and so have



FIGS. 1 TO 6. Scheme of operation.

more tendency to curl, the nail should be shaved flat along the convexity of the superior surface. This is done either with an ordinary emory board or with a sharp knife, the main point being to reduce the actual thickness of the nail along the key of the arch, which is the superior surface of the nail in the mid line.

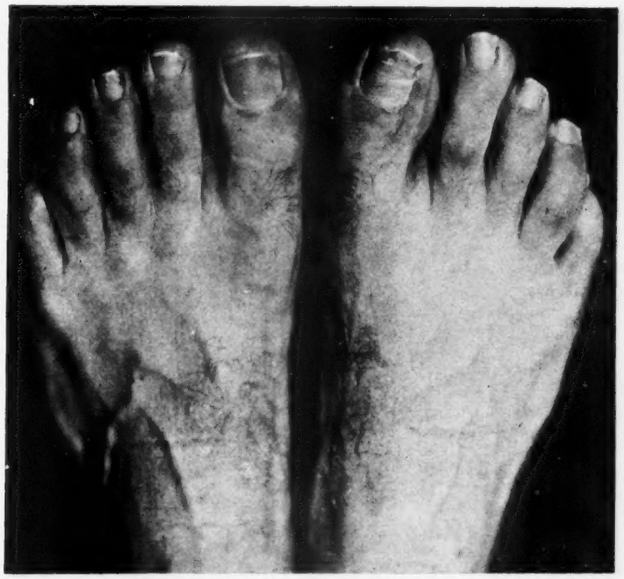


Fig. 7. Typical result on outer margin of toe, right foot, six months after removal of ingrown toe nail.

Conservative Treatment. This classification represents simply an advance from the previous group of preventive treatment, and the same prophylactic management is advisable here as above. However, we are now faced with an actual fait accompli, i.e., an ingrown nail. The problem here also is to reduce the convexity of the nail and so relieve its irritation. If there is acute infection about the nail, measures to control this should be instituted, such as bed rest, hot packs, etc. Provided there is no acute infection present or that this is well under control, we can proceed with other measures which we may hope will cause some relief or even a cure. It is, in my opinion, imperative that the arch of the nail be broken down by thinning the nail in its central portion. This should be carried out meticulously and the nail should be thinned down until it is paper thin in the central portion. This is much better than cutting a section out of the central portion of the nail in order to cause it to flatten. At the same time, as the central portion of the nail is being thinned down, very delicate pressure should be instituted under the lateral margins in an attempt to elevate it away from the soft tissue. This can be done by very careful insertion of a cotton layer completely under the lateral edge of the nail at its distal end. Great care should be taken not to force in a hard plug of cotton which will increase the irritation and increase the pain. A complete layer of cotton first is inserted entirely under the edge of the nail as a protecting pad, and then as elevation is gradually secured, more cotton can be applied until the nail edge is lifted well away from the nail matrix. The nail should be trimmed straight across, great care being taken not to break off the corner of the nail, since if this occurs, it is difficult to progress with the elevation of the corner of the nail until it has grown out sufficiently to permit insertion of cotton under the corner. After the acute condition is once controlled, care must be taken to prevent a recurrence of the convexity of the nail. It may be necessary for the patient to continue to keep the nail flat and thin in the central portion and to keep a little cotton under each corner of the nail. Here, again, it is extremely important that the shoe be

well fitted, not too tight, not too short and that any inbalance of the foot be corrected.

Surgical Treatment. If the condition is intractable and will not respond to conservative treatment, or if the nail is so obviously deformed that conservative treatment will fail, surgical treatment should be resorted to and offers the promise of a very excellent result. It is extremely important to eliminate any active infection prior to surgical excision, since the proper surgical procedure necessitates a considerable incision and one hesitates to do this when there is acute infected tissue. There are many operations for relief of this condition and many of them are excellent.

The requirements of the operation are as follows: It should relieve the overgrowth of the perionychium over the lateral margin of the nail; it must remove a section of the lateral margin of the nail sufficient to get back to fairly flat nail; in other words, remove the convexity of the margin; it is absolutely essential that the nail bed and root of this excised portion be entirely removed at the time of the operation. If it is not removed, the nail growth will recur with a very excellent chance that the deformity will return with it or, more likely, result in spur formation. One cannot stress too much the absolute necessity for eliminating entirely the nail bed and root of the resected portion.

The operation which I have employed with a great deal of satisfaction is as follows: Great care is taken in preparation of the toe to clean up infection around the toe nail and to secure as much cleanliness as possible. Operation is usually done under a local anesthetic, using 2 per cent novocain (with adrenalin, if there is no evidence whatever of any peripheral vascular disturbance). The anesthetic must be a block around the base of the toe rather than local infiltration. The block should be carried out by two dorsal punctures, the local block entirely encircling the base of the toe. The original incision begins about ¼ of an inch proximal to the eponychial margin, the exact distance depending on the length of the nail root. (Fig. 1A.) It is imperative that this incision extend proximal to the nail root. Incision is carried through to the periosteum, extending along the dorsal surface of the toe nail linearly, paralleling the lateral edge of the toe nail. The exact line of incision depends upon the degree of convexity of the nail. In the ordinary case, some 3/16 to 4/16 of an inch of the lateral portion of the nail is included. Incision is carried throughout the length of the nail and over the end of the toe for approximately ¼ of an inch. (Fig. 1A.) The second incision is made lateral to the nail margin at such an angle so that the depth of this incision will meet the depth of the first incision. (Figs. 1B and 2B.) In other words, a triangular section of tissue is removed (Figs. 2C and 3C), including the lateral margin of the nail, the perionychial redundancy and the soft tissue down to the periosteum. After removal of this section of the soft tissue, this section should include toe nail, nail bed, nail root and the perionychium. This will leave a gaping wound which shows no evidence of nail bed or nail bearing tissue. (Fig. 3.) The wound is carefully inspected to be sure there are no residual portions of nail bearing tissue and the wound edges are partially approximated by a stitch or two proximal to the nail and one distal to the nail. (Figs. 4 and 5.) In the ordinary case, this will leave a gap along the nail margin of about ⅛ of an inch between the edge of the nail and the lateral incision. This area is allowed to granulate in and the ideal result will consist of a flat toe nail with no redundancy of the perionychial tissue. (Figs. 5 and 6.)

After treatment consists of ordinary dressing until the wound is healed. Usually, it is advisable to keep the patient off his feet for a few days, particularly if it is necessary to resect both sides of the nail or if the condition involves both feet. Following a successful removal (Fig. 7), there should be no tendency whatever for return of deformity. If all the nail bearing tissue is not removed, spur formation will result which will necessitate local removal.

BONE SINUSES AND THEIR TREATMENT

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I DO not think any physician doing bone surgery has even a feeble interest in the subject of bone sinus except when he has one to treat, and then it is his earnest wish to pass it on to his worst enemy. History has shown that it has been a serious problem for all of us, which accounts for the numerous methods that have developed. I will admit that probably I have had as many, if not more bone sinuses to treat than most men.

Before the World War our attempts at treatment were more or less pathetic, results indefinite and our patient's confidence in us more or less shaky, and I am afraid they are still so to some extent. Even now, some of the looks received from patients as the condition fails to show the improvement promised, do not leave one feeling too sanguine.

During the War, at one time when I was working with the British at Alder Hay Military Hospital, Liverpool, England, we had about 325 cases of acute and chronic osteomyelitis under our observation and were getting no where.

Rutherford Morrison of Newcastle, England, was at that time perfecting his method, which was becoming successful. I obtained permission from my Chief to go there and study the method. Mr. Morrison made no restrictions as to the patients to treat, but treated them differently according to conditions found. It was called the Morrison "Bipp" treatment. In the chronic bone type which is continuously discharging, *x*-rays would be taken as a diagnostic medium. Sometimes a sequestrum was in evidence, sometimes not, and in many instances when not shown in *x*-rays, it would be found in the field nevertheless. Morrison laid stress upon the fact that the thing of greatest importance was to be sure to remove all dead bone, otherwise, even his method was not successful.

TECHNIQUE

First, when a tourniquet can be used, it is advisable to use one not more than an hour on the arm, but two to three hours on the leg. This produces a dry field and the difference between dead spicules and sclerosed bone as against normal bone can easily be determined.

Run a probe down into the pocket and leave it there. Then make a generous incision down to the bone, above and below meeting at the probe and carefully peel away the soft structures and periosteum to obtain a good view. The opening in the bone may be quite small but the pocket fairly large, in which lies the sequestrum. It will be necessary in many instances to use hammer and chisel, to enlarge the opening materially; in fact, it is advisable to do so in order to have a clear field. Smooth and round out the edges of the opening. Investigate the cavity very carefully, thoroughly curetting the pocket, which may be found lined in some direction with sclerosed bone, which presents an ivory color and is as hard as ivory. This must all be chiseled away until normal spongy bone is reached. When the surgeon is satisfied that he has a healthy field in which to work, he can drench the pocket with full strength alcohol and dry out the cavity thoroughly.

Spread bipp* on a piece of gauze, rubbing it into the gauze; transfer this paste in the gauze all through the cavity, making a thin film all through the bone and muscle tis-

* The composition of bipp is one part bismuth subnitrate, two parts iodoform and q.s. paraffin oil sufficient to make a thick paste. Some companies in this country are selling bipp, but use vaseline as a base; it will not work satisfactorily. This preparation must be mixed thoroughly until it has a complete yellowish color.

sues. Prepare the abdomen by cleansing it with a one in two carbolic acid solution, the same as was done to the field of operation, which I failed to mention before. Then make an incision and remove a pad of fat sufficient to more than fill the cavity. Care should be taken not to bruise the fat tissue more than necessary. Place the fat in the cavity so that it fills the whole area and clip off the extruding fat level with the bone. After this remove the fat, gently rub the bipp over its outer surface and replace it in the cavity. Following this apply the bipp to the outer tissues and close the wound with interrupted silkworm gut sutures. Where there is any tension of the skin, undermine the soft parts which will give more tissue in closing. After closure put on a heavy fluffy dressing and leave it alone for ten to twelve days. There will be some discharge in the dressings during that time, but even in the presence of pus the tissues will show healing. In this manner work is cut down in the hospitals tremendously. If structures cannot be closed without tension, use the Orr treatment.

Chutro of Paris worked out a system which I saw at Savenay, France. Whether it was his or Carrel's idea, or both, I do not know; but he made a long saucerized area in the bone, washed it out with green soap and water and packed the whole area with gauze soaked in Carrel Dakin solution. This was repeated every second or third day, and from what I saw is a very painful procedure.

The Carrel Dakin drip treatment is familiar to all of us. My difficulty in using it has been to know how long to use it and when to do a secondary closure. If there is still a discharging sinus, we must go in and find the offender.

The Orr method of treatment described by Winnett Orr of Lincoln, Nebraska, with which we in this country are all thoroughly familiar and which does not call for description, is very successful. I have used it many times on selected cases, and Dr. Orr deserves considerable commendation for working it out.

The Maggot Treatment. It is not necessary to go into that except to say that the author of this treatment deserves just as much credit for his explorations along this line as any other man, and he may be using it very successfully. My difficulty was in proving to my patients that one live animal could live on another successfully to the benefit of each. It was just one of those things where psychology entered into the matter. Our difficulty, after getting the maggots into the finest of wire cage over the affected area, was to try to find out where they had gone when we checked up the following morning. Hence this method had to be eliminated. I am not condemning this method but it was not successful in my hands.

CONCLUSION

Probably some one of our associates has found a perfect cure for this condition. If he has, will he please publish it. It is one of the most trying conditions to deal with and so far, is not 100 per cent successful. My own method in these cases is the following: Assuming that it is a chronic bone sinus, I take a plain *x*-ray and see if it shows a sequestrum. At the same time I also inject into the sinus "Beck's Paste" which may surround the spicules, but also shows the ramifications of the sinus. Sometimes in doing this I have been very pleased to find that the Beck's Paste has succeeded in closing the sinus entirely. I have tried silver nitrate sometimes successfully where Beck's Paste has failed to obtain results. I have used a saturated solution of potassium permanganate irrigation with fair results; I have used peroxide of hydrogen followed with potassium permanganate with occasional good results; I have used autogenous vaccine, occasionally with good results. I have obtained fair results in trying all of these, but none which I would consider a cure-all.

TREATMENT OF SIMPLE SHOULDER SPRAINS

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THE following is a brief consideration of the treatment of shoulder sprains and a complication, occurring not infrequently, which is a scapulohumeral fibrosis or stiff shoulder. These injuries are commonly seen in office practice and usually arise from straining in lifting or shoveling or result from falls, twisting or striking the shoulder.

Pain is the principal complaint and is expressed with the shoulder at rest or in motion; discomfort may be immediate or it may develop several hours or days after injury. Subjectively, acute or aching pain is experienced over and through the entire shoulder girdle, or may be limited to a point around the acromion, or extend down the region of the deltoid to above the elbow or palpation over the long head of the biceps, or sometimes is localized to the posterior aspect in the region of the scapula and occasionally at the root of the neck. Subjective discomfort is increased with abduction of the arm or carriage of the arm to full, overhead position. Motion is sometimes accompanied by muscular spasm and in this instance limitation of varying degrees is encountered.

In long-standing cases of a month or more in duration, the arm is frequently held in the anatomic position at the side of the body because of subjective pain that is produced on motion. This may result in considerable "stiffness" of the shoulder or what we like to term a scapulohumeral fibrosis. This is similar to Dr. E. A. Codman's "frozen shoulder" and is characterized by greatly limited motion of the arm, particularly in abduction, overhead position and internal rotation. Outwinging of the scapula is present on abduction of the arm and when the arm is passively raised the whole shoulder girdle is lifted.

TREATMENT

Treatment of the sprain, either acute or "chronic," is directed to achieve a twofold purpose: to relieve pain and restore motion. In the event that pain and discomfort are intense after injury, the shoulder is exposed to infra-red heat for approximately twenty minutes and then supported by means of a sling. Adhesive taping is avoided. Codeine and aspirin are given in liberal amounts and the patient instructed to use dry heat, electric pad or hot water bag at home. He returns at two or three day intervals for infra-red heat or diathermy and massage therapy. The sling is usually discarded within a week. Not infrequently, full passive motion is readily achieved, but actively the patient experiences "weakness" in holding the arm in abduction or in overhead extension. The addition of sinusoidal stimulation to the musculature about the shoulder girdle is beneficial in these instances.

Briefly, the technic of massage and the exercises to increase shoulder motion are summarized as follows:

1. Twenty to thirty minutes of infra-red heat exposure.

2. Massage first the involved upper extremity, starting at the hand, using a circular movement and working up to the shoulder. Incidentally, use a suitable massage cream and after treatment wash off the cream with 70 per cent alcohol.

3. Holding the patient's arm in an overhead position, the anterior portion of the chest is massaged, using a circular motion.

4. With the patient's arm in abduction exert traction on it with one hand and with the other hand "iron out" the axillary region, using a stroking motion.

5. The patient sits down in front of a table, folds his hands on the table top with

head bent forward. Massage the musculature over the scapular region.

6. With the patient in a sitting position and the physician behind him, grasp both elbows and commence circular movement of the patient's arm, first in clock-wise then counterclock-wise direction.

7. Employ passive internal and external rotation of the arm.

The active exercises which the patient can do at home are:

1. Wall creeping: The patient faces a wall at about a foot's distance, places palms of his hands flat on the wall and works them in a creeping movement as high above his head as possible, He should attempt to increase the height each day.

2. Standing sideways the hand is placed flat against the wall and upward creeping commenced.

3. Two pulleys are rigged in the ceiling of a porch or basement and placed about four feet apart. A rope is strung through them, a weight (starting with one pound) is attached to one end; the patient grasps the other end raising and lowering weight and permitting his hand to be pulled as high above his head as possible. Weight is increased daily or weekly as improvement is noted.

If a scapulohumeral fibrosis is encountered, either from a neglected sprain or one which fails to respond to the usual therapy, shoulder wrenching and manipulation under deep general anesthesia is indicated. Such an operative procedure is used to break up adhesions and passively produce full shoulder motion. *X*-rays are first taken of the shoulder to rule out bone pathology. The technique follows:

The patient is given ether and thoroughly relaxed. While the assistant anchors the scapula by placing the heel of his hand against the outer border of the scapula, the operator grasps the upper third of the arm with both hands and slowly and with even pressure, gradually forces the arm into a full overhead position. Distinct "cracking" is often heard during these maneuvers as the scar tissue and adhesions break down. The danger of fracture or dislocation is negligible as long as care is taken not to hurry or to use a jerking force against the arm.

Postoperative care consists of the usual routine and the tying of the wrist above the head of the bed to maintain an overhead position of the arm. This is continued for about four to seven days, after which the patient can report to the office for follow-up treatment, of heat, massage and exercises. No slings or braces are necessary.

Results are usually satisfactory, and even in shoulders that have been fibrosed or frozen over a period of several months or more, good functional shoulder motion can be achieved by wrenching and follow-up care.

The length of disability and treatment required for simple sprains may vary from a week to several months. Usually, in individuals who are advanced in years or who are muscular and heavy, the recovery period must be expected to be longer. In those patients requiring shoulder wrenching and follow-up care, recovery may extend over four to six months.

BURSITIS

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THIS paper attempts to give the views of an industrial surgeon, based on twelve years of experience in association with Dr. C. R. G. Forrester, Dr. A. H. Mason and recently with Dr. C. C. Coleman. During this time we have examined or treated about 3000 industrial patients a year, about a fourth as many private patients and have had occasion to handle many examples of bursitis among the other lesions. We have had to work out certain basic rules of treatment to simplify therapy and to learn by precept and largely by experience the most efficient and successful methods of achieving satisfactory results. Bursitis is common, particularly the olecranon and prepatellar types; it is often poorly treated by the general practitioner; it is a lesion suitable for office treatment in most instances, as only the severe infections and most surgical excisions require hospitalization.

Definition of Bursa. Dr. John Homans, a valued teacher of mine, in his Textbook of Surgery, 1931, defines a bursa as "a thin-walled fibrous sac lined with a specialized layer of cells which secrete a thin synovial fluid and under normal conditions the opposing surfaces glide freely over one another. Its function, like that of the synovial sac of a joint, is one of lubrication. Bursae are so disposed in various parts of the body, between structures which muscular effort causes to glide upon each other, that undue wear and tear upon the opposing tissues is prevented. Thus they are found between subcutaneous tissue and a joint capsule, between a joint capsule and bone, between bone and overlying soft tissue parts, between crossing tendons, and even between muscles. They frequently communicate with joints."

Causes of Bursitis. The causes of bursitis may be tabulated as follows:

1. Traumatic
   - (*a*) Actual wound of a bursa; of puncture, contused, incised or lacerated type
   - (*b*) Direct contusion over bursa
   - (*c*) Sudden violent motion or twist
   - (*d*) Repeated minor traumas
   - (*e*) Overuse sufficient to cause irritation
2. Infectious
   - (*a*) Common pyogenic organisms
   - (*b*) Gonococcus
   - (*c*) Tubercle bacillus
3. Toxic

Obscure or biochemical disturbance elsewhere in the body; nonbacterial, but otherwise resembling infectious bursitis. Distant foci of infection, or absorption of abnormal substances by the intestinal tract may have an influence (Homans).

Description and Complications. A contusion over a bursa is often sufficient to cause a fluid extravasation into the bursal sac (a yellow sticky fluid of synovial type). A more severe contusion causes blood extravasation into the bursa. The wounds of bursae most commonly seen are small, often caused by a blow from a blunt object, as in a fall, or by some sharp object causing a puncture, as in kneeling on a nail or tack. A bursa can become infected from a simple contusion (rare), but a puncture or contused wound into a bursa is the most frequent cause of the troublesome infections seen in this sac. If the infection stays confined to the bursa, a purulent material fills and bulges it; if the infection spreads through the sac wall, a more or less extensive cellulitis ensues and even forms a widespread abscess which follows the tissue planes, either in the subcutaneous or in the deep fascia. All too often uncontrolled or neglected bursal infection will smoulder along for several weeks and finally involve

the underlying bone (olecranon chiefly). In one case we found the entire olecranon process and the proximal fourth of the ulna osteomyelitic, and pus had invaded the elbow joint. A chronic bursitis leads to bursal wall thickening, tabs, villous enlargements, adhesions, or even calcareous deposits in the bursa, or a spur on the underlying bone.

Diagnosis of Bursitis. In general, bursitis is diagnosed by the history, together with the signs of swelling, tenderness, redness if inflammatory reaction has occurred, slight to moderate pain on motion of the underlying joint, the pain occurring when the joint position puts a stretch or pressure on the bursa, as flexing the elbow in olecranon bursitis, flexing the knee in prepatellar bursitis, hyperextending the knee in popliteal bursitis or abducting the arm in subacromial bursitis. A puncture or contused wound over the region of the patella or olecranon should always be watched closely for a possible invasion of the bursa with either a simple bursal effusion or more likely a purulent infection in the sac. A typically swollen bursa forms a rounded prominence, moveable, often of large size at the patella and olecranon, fluctuant and only slightly tender. In chronic bursitis the sac often becomes thickwalled and is "pebbly," "wormy," or "gritty" to palpation because of the presence of tabs or villous thickenings in the bursal lining.

TREATMENT

I wish to condemn most strongly the common practice of aspirating bursal effusions, except where fluid is wanted for diagnosis of possible tuberculous, gonococcal or other rare cause. In the first place, the aspirated fluid is replaced in a few hours by more fluid produced by the irritated or injured synovia; secondly, the single or repeated needlings of a simple uninfected bursal effusion frequently leads to the unfortunate result of an infected bursa, with the possible complications already mentioned. Needless and dangerous aspirations are done by many practitioners. Stab drainage or incision alone is also contraindicated in my opinion.

1. *Conservative Treatment.* We treat a simple or uninfected bursitis of the olecranon or prepatellar type (which are the most commonly encountered), where there is no open wound into the bursa, by a rubber sponge pressure dressing applied as follows: For example (olecranon), apply sheet wadding around the elbow, or wrap the sponge in a clean bandage to keep the rubber from direct contact with the skin; then apply the sponge rubber pad over the swollen bursa. The pad is cut to shape from an ordinary red rubber bath sponge and should be larger than the bursa. Bandage the sponge into place to compress the bursa firmly, taking care not to embarrass the circulation of the extremity, (we use a cotton and gauze pad at the antecubital or popliteal region); rebandage every two or three days. The sponge expands as the swelling of the bursa subsides, and thus exerts a continuous elastic pressure which in our experience effects a cure in two or three weeks, and is much more effective than the former methods of hot packs, hot baths or aspiration. A saturated solution of potassium iodide in doses of ten to fifteen drops by mouth three times daily is a useful adjunct as it hastens the resolution of the effusion and bursal thickening. If the patient has to continue at his work, we use the bandage-covered sponge held in place over the bursa by an elastic bandage or a well-fitted elastic supporter (for the elbow or knee), thus allowing fairly good joint motion during the cure.

X-ray is always advisable in diagnosis, as a check on treatment, to determine bone injury, development of a spur under the bursa (this is not uncommon at the olecranon), fracture of a pre-existing spur or signs of cortical osteitis or osteomyelitis. If the bursitis does not subside quickly, progress *x*-rays are strongly advised.

If a bursa is acutely inflamed, with or without a surrounding cellulitis or lymphangitis, we use continuous hot boric

fomentations and elevation and rest of the member, until such time as the inflammation has subsided or become localized to the bursa, whereupon bursectomy is usually indicated for a cure.

2. *Surgical Treatment.* Aspiration and simple incision of a bursitis usually are not curative; nor is the injection of sclerosing solutions nor simple curettage effective. We do a complete excision of the long existent bursitis, as in occupational bursitis, when the conservative measures have been given a fair trial (two or three weeks) and proved ineffective. Where there is no infection, simply a localized nontender simple bursal effusion or simple chronic bursitis, the bursectomy can be done in the office or hospital under local anesthesia. We use 2 per cent novocain in the skin and around the borders of the sac. Where there is any question of infected material in the picture, the bursectomy should be done in the hospital under general anesthesia. In operating, we always use a curved or semilunar incision, approximately in line with the bursal edge and extending halfway around its border. We carefully dissect back the flap of skin and fat in one layer over the whole bursa, taking care not to button-hole the skin, then dissect out the whole bursa in one mass, taking it off the underlying bone or fascia cleanly, tie all bleeders with small plain catgut and close the skin with interrupted silk sutures. We insert a small rubber dam drain to allow escape of extravasating blood and serum. This drain can be removed in forty-eight hours; the sutures are removed on the seventh day and the skin then cross-taped with butterfly adhesive strips for a further period of seven to fourteen days. This adhesive support prevents scar spreading, which is prone to occur with elbow or knee flexion. The curved incision is so placed that it will not leave a scar directly over a boney prominence, as olecranon or patella, and to avoid pain on kneeling, bumping or friction. The radical removal of a bursa, if done on these general principles, gives a good functional result, allows full motion of the joint and the scar is freely moveable in a few months.

In olecranon bursectomy we advise placing the arm over the patient's body, while operating (attach the hand to the other side of the table by a soft roller bandage around the wrist), thus making the operative approach easy. Make a posterolateral curved incision and stay away from the ulnar nerve, which lies in a tunnel or groove only about a half inch from the medial edge of the bursa. The bursa will be found firmly attached to the bone and triceps reflection.

Where a purulent infection in the bursa has invaded the underlying bone, the operation includes not only total bursectomy but curettage of all infected bone. This complication is beyond the scope of this paper, and must be treated by one of the accepted methods for osteomyelitis, preferably the Orr method of saucerization and vaseline pack. If only a small area of the cortex is involved, we sometimes treat this with Bipp* after curettage. After bursectomy and bone curettage, the area is drenched with 70 per cent alcohol, dried, then the Bipp is spread on gauze and rubbed thoroughly into the bone surface, the excess Bipp wiped away and the skin closed in the usual manner without drainage. This is the Morison method of treating osteomyelitis. The bismuth and iodoform are slowly absorbed and act as mild antiseptics, so that the wound heals almost per primam with very little drainage of pus or serum. If bursectomy is done in the office (and never on infected bursae), it must be done under as strict a surgical technic as in the hospital in order to be successful.

Instead of using Bipp, when we deal with potentially infected fields in bursectomy, we sometimes use iodoform-ether solution (formula is 29.75 cc. of sterilized powdered iodoform to 118.30 cc. of ether), drenching the deep tissues with this before closure of the wound. The ether is a good fat solvent

* Bipp is an abbreviation for bismuth iodoform paraffin paste consisting of bismuth subnitrate 1 part, iodoform 2 parts, and mineral oil q. s.

and diffuses into all areas of the wound. As it volatilizes, it leaves a film of iodoform in the tissues to act as a slowly absorbing antiseptic.

One should be familiar with the workmen's compensation law of the state in which one practices, as it has a bearing on the handling of bursitis cases in industrial practice, particularly occupational bursitis. The insurance carrier for the employer in question may deny liability; for instance, in Illinois, employers may or may not carry "occupational disease" coverage in their compensation policies. This matter of liability should be checked through the insurance carrier before you enter on the treatment of the industrial bursitis case, to determine who is to pay the cost of medical care.

BURSITIS BY REGIONS

1. *Shoulder Bursae.* (*a*) *Subacromial or subdeltoid bursitis* is not uncommon but should be distinguished from other affections of the shoulder. This bursa is about the size of one's palm and lies under the deltoid muscle and acromion process which form its roof, and over the attachment of the supraspinatus tendon which forms its floor. Bursitis here can be of toxic origin, come on suddenly from obscure causes, with acute pain, sometimes crepitation, inability to abduct and rotate the arm outward, tenderness and indefinite swelling or no swelling, and early deltoid atrophy. This toxic bursitis usually responds quickly to rest and heat. If it lasts longer than a few days, it should be treated in an abduction splint, especially in a person over forty.

A shoulder twist or sprain is sometimes severe enough to injure the supraspinatus tendon attachment to the greater tuberosity of the humerus, with or without a cortical tear, and can wholly or partially tear loose this tendon. In so doing, it invariably injures the floor of the subacromial bursa, causing the characteristic signs pointed out by Codman in his book on supraspinatus injuries; faulty abduction, pain, swelling, spasm and hesitancy on abduction. This combined bursal and tendinous injury can be treated conservatively by forward abduction in an airplane splint, heat and rest, followed by increasing exercises off the brace as the pain subsides; or if intractable pain and loss of abduction persist, it can be treated by Codman's operation on the tendon, together with resection of as much of the damaged bursa as can be reached.

Chronic subacromial bursitis often shows by *x*-ray a characteristic proliferation of bone or calcareous deposits close over the greater tuberosity of the humerus.

We find that most of these bursal irritations respond well to conservative treatment. An abduction brace (airplane or Littler Jones splint) is often necessary for six to eight weeks, or until the patient is able to elevate the arm under its own power off the brace and hold it in full abduction for at least five minutes. Then we remove the brace and continue infra-red heat lamp and massage treatments at two day intervals, combined with passive and active exercises, till restoration is complete. The shoulder can compensate for a rather severe supraspinatus and bursal injury under a conservative program.

Carefully differentiate a true subacromial bursitis from other lesions such as: traumatic synovitis of the shoulder joint proper, arthritis, scapulohumeral fibrosis, acromioclavicular separation, rupture of the supraspinatus or infraspinatus, or of the long head of the biceps, muscle sprain, brachial neuritis, myositis and myalgia. One important contrast is this: In true shoulder joint involvement, which is intracapsular, the characteristic tender point is anteriorly over the region of the long head of the biceps brachii; in subacromial bursitis, the tenderness is under the middle belly of the deltoid, that is laterally at the shoulder.

(*b*) *Other shoulder bursae* are rarely inflamed compared to the subacromial. Coracobrachialis bursitis causes anterior pain and localized tenderness; acromial bursitis is seen as a result of habitual fric-

tion or weight bearing on the shoulder (as in porters and hod carriers). This causes an adventitious bursa to form between the calloused skin and the acromion, and the sac can be excised if painful.

2. *Elbow Bursae.* (*a*) *Olecranon bursa* ("miner's elbow"). This is very commonly involved in bursitis, is often injured by a fall contusing or wounding the bursa, or irritated by repeated knocking of the elbow against objects, as in working with tools in close quarters (miners, plumbers). This bursitis is easily diagnosed by its rounded, fluctuant prominence over the point of the elbow. The bursa is located between the skin and the tendinous expansion of the triceps insertion over the olecranon. The bursal floor is usually firmly adherent to this aponeurosis and often has vertical fibrous bands tying it to the olecranon, a point to watch in dissecting out the bursa. A wound of this bursa should be treated carefully as it can become infected very easily and result in a nasty infection invading the bursal wall. Rarely a widespread cellulitis of the arm can involve the olecranon bursa, invading through its wall. A simple uninfected olecranon bursitis we treat conservatively by sponge pressure; if chronic, intractable, or infected, we treat by bursectomy.

(*b*) *Radiohumeral bursitis* ("tennis elbow") was described by Dr. Robert Osgood of Boston. This bursa is located between the common tendon of the extensor muscles of the fingers and the supinator brevis muscle, overlies the radiohumeral joint and is irritated by repeated violent extension of the wrist in the pronated position, as in using a tennis racquet. This bursitis causes severe pain and localized tenderness, and disables the arm for tennis sometimes for several months. Treatment is by prolonged rest, heat and supportive dressing. It is liable to recurrence. Radical cure is by bursectomy.

(*c*) *Other Bursae at Elbow.* The interosseous and bicipitoradial bursitis types are mentioned by John Homans and others as occasionally found but they have been rare in my experience. The cause is the irritation from repeated violent motions of the arm, as in pitching base ball. There is localized pain on contraction of the biceps with the forearm pronated. The ulnar and radial bursae in the hand are really tendon sheaths and should be treated as such. Their inflammations are outside the scope of this discussion.

3. *Hip Bursae.* (*a*) *The gluteal bursa* lies between the great trochanter and the origin of the gluteus maximus and vastus externus muscles, is large, constant, and subject to trauma from blows or falls, and when inflamed it causes pain at this location on flexion and internal rotation of the hip. There is localized tenderness and swelling of the bursa. Gluteal bursitis is rare in my experience. It is seen occasionally as a complication in hip fracture. Rule out hip fracture, osteomyelitis or hip joint disease by *x*-ray. If this bursitis does not yield to rest and hot applications, it can be cured by excising the bursa. I had to remove this bursa once in doing a fixation of a slipping iliotibial band for "snapping hip."

(*b*) *The iliopectineal bursa* (iliopsoas bursa) is large, constant, and lies between the iliopsoas muscle and the Y-ligament of Bigelow at the hip. When swollen it may simulate a psoas abscess or femoral hernia. For comfort the patient flexes and externally rotates the thigh. The disease is uncommon. If chronic, the bursa can be excised, approaching it along the inner border of the tensor fasciae femoris, well lateral to the femoral vessels.

(*c*) *The ischial bursa,* when inflamed, causes a characteristic disease variously called "Weaver's Bottom," "Tailor's Bottom" or "Lighterman's Bottom." The irritated bursa may reach a large size. The bursa lies between the ischial tuberosity ant the origin of the hamstring muscles, and is in contact with the deep surface of the gluteus maximus muscle. A sitting trade and horseback riding can cause such bursitis. I saw one instance following a heavy fall in which the patient landed in a sitting position. However, the bursal swell-

ing subsided over a period of about three months. The pain in ischial bursitis is probably caused by pressure on the inferior pudendal nerve. Bursectomy here is difficult due to the deep location and the rich blood supply adjacent.

4. *Knee Bursae.* (*a*) *Prepatellar bursitis* is very common. It often follows repeated or occupational trauma especially by kneeling work, hence the name, "housemaid's knee." I have seen it in janitors, plumbers, bricklayers, carpet layers and cleaning women. The swelling is often very large, forming a "hydrops" of the bursa. Puncture wounds of this bursa (as from kneeling on a tack or nail) are a common source of the infectious bursitis. Rarely the bursa is secondarily infected from a surrounding cellulitis. The sac lies between the skin and the deep fascia overlying the patella and is usually closely adherent by tough fibrous strands to the bone or deep fascia (quadriceps aponeurosis). Conservative treatment is by sponge pressure, in the simple uninfected bursitis cases; radical cure is by complete excision of the sac. Aspiration treatment is highly inadvisable. Incision and drainage alone, curettage and injection of sclerosing chemicals are useless in effecting a cure.

(*b*) *Infrapatellar bursitis* is not so common as the prepatellar type. This bursa lies between the patellar tendon and the anterior surface of the tibia above the tibial tuberosity, and is separated from the anterior chamber of the knee joint by a thick pad of fat. The bursa is inflamed or swollen at times from the repeated traumas of a kneeling trade, can also be infected from a puncture wound, and is sometimes inflamed in connection with Osgood-Schlatter disease (tibial tuberosity epiphysitis of adolescence). This bursitis is characterized by swelling, local tenderness and pain on kneeling, or on pressure over the patellar tendon region, not over the patella itself. A simple infrapatellar bursitis usually responds to sponge pressure dressings. If infected or chronically persistent, it can be excised easily, taking care to place the incision laterally or medially to avoid injury to the patellar tendon, to keep out of the knee joint and to leave a scar that will not be pressed on kneeling.

(*c*) *The Bursae of the hamstrings* can be irritated by overexercise or strain of the knee. These bursae are small, their swelling is usually brought out to inspection and palpation by having the patient hyperextend the knee. There are many bursae here that may become involved in bursitis. There is tenderness on pressure, pain on knee extension, and knee flexion relieves pain and causes the swollen bursa to sink out of sight (except the biceps bursae). The bursa anserinus (between the semitendinosus tendon and the tibia), the semimembranosus bursa, and the gastrocnemius bursa, the superior and inferior biceps bursae can be involved. The latter may be injured by a direct blow or squeeze, and this bursitis shows as a swelling overlying the head of the fibula. The popliteal bursa is really a long saccular extension of the knee joint posteriorly under the popliteus muscle, and at operative removal this communication with the knee joint must be recognized and ligated. Patients with popliteal or any posterior knee bursitis are inclined to relieve pain and bursal pressure by walking and standing with the knee partly flexed. We have seen only two cases of popliteal bursitis in the past twelve years, and two cases of the medial hamstring type. Distinguish these bursal enlargements carefully from popliteal tumor, varix, aneurysm, abscess, hematoma and rupture or bulging of the posterior capsule of the knee.

There is a so-called rider's bursa, but this is an adventitious sac superficially placed between the inner femoral condyle and the skin, seen in horseback riders.

We have not been successful in curing the enlarged bursae behind the knee with sponge pressure, or other conservative measures. Radical excision is curative and requires good knowledge of anatomy.

5. *Ankle and Foot Bursae.* (*a*) *The Achilles bursa* is located between the

Achilles tendon and the posterior tubercle of the os calcis. It is irritated frequently by the wearing of stiff new shoes; it can be irritated from unaccustomed long walking or running, also by learning to skate. I saw one young man with bilateral Achilles bursitis caused by his work as delivery boy for a drug store. Walking casts were required for eight weeks. Heat, rest and protective treatment almost always cure the lesion; if intractable, bursectomy will cure but is seldom necessary. Watch for Achilles contracture and consequent foot drop deformity; keep the foot up to a right angle to prevent this.

(*b*) *The subcutaneous heel bursa* lies between the tendo-Achilles insertion and the skin. It can suffer the same irritations as the Achilles bursa. It responds readily to conservative measures. Its swelling is usually smaller, more superficial and distally placed than the sub-Achilles type. It occasionally becomes infected and requires incision or excision for a cure. If excision is done, place the scar where shoe pressure will not irritate the scar.

(*c*) *Bunion*, associated with hallux valgus, is a thickwalled adventitious bursa lying between the calloused skin and the deformed first metatarsophalangeal joint. It is caused by the constant pressure of ill-fitting shoes, and such shoes keep up the irritation. Such a bursa may become grossly infected and require incision and drainage before the recommended radical operative cure can be undertaken. This operation for bunion and hallux valgus should be performed on a "quiet" process, in hospital, under general anesthesia, and should consist of wedge osteotomy and correction of the valgus, combined with removal of the bursa. Temporary relief of bunion can be given by proper shoes and a curved felt pad taped in place proximally to protect against shoe pressure.

(*d*) An adventitious bursa sometimes forms on the *plantar* surface of the heel between the skin and a calcaneal spur which is usually located at the inferior tubercle of the os calcis. A sponge rubber pad worn in the shoe under the heel gives relief, or a felt "doughnut" taped in place. Radical cure is by excision of the bursa and spur but is seldom required. Spur and bursa can recur under the same continued irritation.

SUMMARY

The causes, diagnosis, types and methods of treatment of bursitis are described in general and the bursal lesions discussed in particular by regions. Conservative office treatment by sponge pressure is emphasized for the uninfected types, and excision advised in chronic or suppurative bursitis. Aspiration, injections and stab drainage are discouraged.

DISLOCATIONS OF THE KNEE JOINT

WITH SPECIAL REFERENCE TO ACCESSORY AND AFTER TREATMENT

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THE principles which govern the treatment of dislocations of the knee joint and the general prognosis of these injuries have been set forward in various textbooks at some length and particularly in the February, 1939 issue of this Journal in a symposium on reconstructive and plastic surgery in an article by H. Earl Conwell.

From this in general it would appear that dislocations of a remarkable degree are (1) comparatively easy of reduction if they are uncomplicated by a fracture of the adjacent bones; and (2) that the prognosis for a good functional result in the absence of vascular damage is much better than would ordinarily be anticipated.

That reduction of a dislocated knee is not always possible by manipulative means is illustrated by a case recently under the author's observation.

This patient was a 28 year old woman who subluxated her left knee in a fall going downstairs. The accompanying *x*-ray shows the degree of dislocation. (Fig. 1.) Two attempts at reduction were unsuccessful. On opening the joint six days later it was found that the irreducibility was occasioned by (1) a torn and displaced, internal, semilunar cartilage, and (2) by a transverse tear of the internal lateral ligament. The lower fragment of the torn ligament had been displaced into the joint and wedged between the torn meniscus and internal condyle of the femur. Upon removing these obstructions the dislocation was easily reduced. (Fig. 2.)

The reduction of such a dislocation should always be carried out under general anesthesia with complete muscular relaxation. In this way minimal force can be utilized, thus guarding against further vascular damage should it already have taken place as the result of trauma or lessening the damage of added injury to the blood supply by the manipulation.

It is agreed by all writers on this subject that following the reduction, the joint should be immobilized for a fairly considerable period of time (six to twelve weeks). Therefore, it becomes doubly important to evacuate the invariable hemarthrosis by aspiration and to repeat the operation if re-accumulation of blood occurs. In addition to making the patient vastly more comfortable this measure will reduce the formation of intra-articular adhesions to a minimum and thus shorten convalescence following the removal of immobilization apparatus.

After the completion of the period of complete immobilization, systematic physiotherapeutic treatment including heat and massage, stimulation and exercise of the quadriceps extensor muscle and manipulations to restore motion should be begun. During this process and for a number of weeks the joint should be protected by a light knee cage or similar knee splint.

That a knee joint which has obviously suffered complete tears of the crucial and lateral ligaments should recover with a surprising degree of stability and function is due largely to the development of a vicarious stability dependent upon the integrity of the quadriceps extensor muscle and its lateral expansions, hence the great importance of devoting considerable attention to the development of this muscle in the convalescent phases of treatment.

Conwell advocates waiting one year before evaluating the end result of dislocations of the knee. If after this priod of time the knee remains actively and passively unstable in either the lateral or anteroposterior planes, it is advisable to attempt repair of the anterior cruciate ligament.

The author some years ago reported a series of cases of operative repair of unstable knees by a modification of the Hey-Grooves technic for reconstruction of the anterior crucial ligament. Such operative repair has proved successful in the majority of cases. Such an operation either by this technic or the technic of Gallie is indicated in these cases because if successful the functional result is excellent, but if unsuccessful the alternatives are either permanent brace wearing or an arthrodesing operation on the knee joint.

Fig. 1. *X*-ray showing a fresh and irreducible subluxation.

Fig. 2. *X*-ray following operative reduction.

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EMERGENCY TREATMENT, TRANSPORTATION AND EARLY MANAGEMENT OF FRACTURES*

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THIS discussion refers to the care of the fracture from the time it is sustained until definite treatment is given, usually in a hospital. It thus includes first aid at the place of the accident, splinting for transportation and the early maneuvers in handling the patient in the hospital, including making the diagnosis, *x*-ray studies, treatment of compounding, etc. Fractures of shafts of long bones differ from joint fractures and those of small bones. The former have much more tendency to displacement, shortening and avoidable loss of function. Weight-bearing bones take longer to heal and require more perfect reduction and retention to give good function. Above all, the question of infection in compound fractures influences the immediate and subsequent treatment fundamentally.

Although emergency therapy of these injuries is really a part of the definitive management, we shall attempt to discuss it chronologically by taking the patient at the site of the accident and tracing him until the fracture is actually reduced, held and functional restoration begun. These are the cardinal steps in any fracture treatment:

1. FIRST AID TREATMENT

A. Prevent Shock. The degree of shock depends on the circumstances of the accident and associated injuries as well as the treatment received. Shock is minimized by: (1) Maintenance of body heat by warm blankets, hot fluids and prevention of undue exposure in transportation; (2) avoidance of all unnecessary manipulation. If indicated, only the mildest efforts to correct very gross deformity are permissible before proper *x*-ray study and anesthesia. (3) Adequate sedation by morphine to relieve pain; and (4) proper splintage before moving the patient. This is of great aid against shock by stopping pain.

B. Preliminary examination must be adequate but rapid, and should be made simply to detect gross injuries, deformities, open wounds requiring protection, bleeding requiring control and necessity for splintage. Clothing should be removed only sufficiently to uncover possible wounds in relation to the fracture. In the case of lower extremity injuries above the ankle, the shoes are left on.

C. Hemorrhage from compound fractures per se is usually of little consequence unless extensive soft tissue injury has occurred. Tourniquets should rarely be required; direct pressure by sterile gauze and bandage is preferable.

D. Proper Splintage. This is a crucial point in early management of fractures of the shafts of long bones. "Splint 'em where they lie" is the rule to be followed. By far the most efficient emergency splint for application in such cases is the Thomas traction arm or leg splint or some modification thereof; the most usual ones are the Murray-Jones or Thomas-Murray arm splint (Fig. 1), and the Keller-Blake half ring army leg splint. (Fig. 2.) Traction is applied manually to the foot (or hand) at first, and then by a hitch or traction strap around the ankle (or wrist). Countertraction is derived from the pelvis (or axilla). The limb is supported by bandages or slings from the side bars of the splint with special care to keep the joints immobile.

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All ambulances in New York City municipal hospitals and many other large public hospitals are equipped with such splints and the materials necessary for their application.

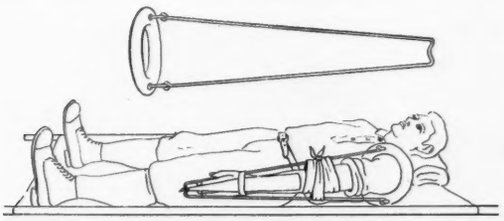

FIG. 1. Thomas-Murray hinged splint, for upper extremity fractures. Note slings to arm, traction on forearm, elbow extended. Whole upper extremity at side of body. (From *Outline of Treatment of Fractures*, by Committee on Treatment of Fractures, American College of Surgeons.)

It is a standing rule, impressed on each ambulance surgeon, that suspected long bone fractures must never be moved from the site of the accident without preliminary application of such protection. Such prompt action prevents overriding of the bone fragments due to muscle spasm, needless bruising of soft tissues, compounding of previous simple fractures and shock, by relief of pain while the patient is being moved. Indeed, it is a common finding by *x*-ray, in fractures of the long bone shafts of the arm or leg, that the original position in the Thomas splint is more perfect than the final one in the retentive apparatus. This is merely due to the greater efficiency of early continuous traction. This lesson was brought home during the first World War, when the simple introduction of the traction splint cut the mortality and end results of compound, long bone fractures tremendously. Every physician should know, by actual trial and training, the technic of proper application of these splints if he treats any fractures at all.

Small bone fractures and joint fractures, in general, do not require more than simple splintage, use of a sling in the upper extremity, and nonweight bearing in the lower extremity during transportation to a hospital. Care, of course, is to be taken so that undue motion at the fracture does not occur or that jarring does not cause too much pain. Voluntary splintage and support by the uninjured extremities of the patient himself often suffices with simple additional means as above mentioned.

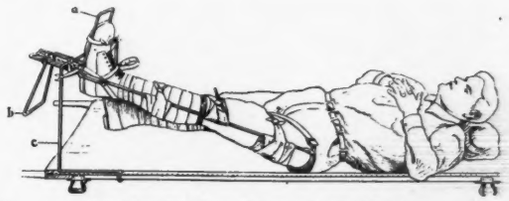

FIG. 2. Keller-Blake hinged half-ring splint for transportation and first treatment of fracture of the leg and thigh. (From *Outline of Treatment of Fractures*, by Committee on Treatment of Fractures, American College of Surgeons.)

In any severe back injury, the possibility of vertebral compression fracture must be considered. This is especially important where any neurological lesion (paralysis, anesthesia, etc.) is detected. By far the greater number of such vertebral body compressions are sustained in acute flexion by "jack knifing." It is only further flexion which will aggravate the injury or produce spinal cord damage where none was present.

It is vital that patients be not carried by the shoulders and legs all in a heap; this results in further flexion of the trunk. (Fig. 3.) Such patients should be moved with extension of the spine maintained in one of a number of ways. An ambulance is best used to move them. For the cervical region, the patient is placed horizontal, on his back, with a pillow or blanket under his shoulders, so that the neck is hyperextended by the weight of the head hanging backwards. In the lower dorsal and lumbar region, the supporting pillow or blanket roll, etc., should be under the suspected site of fracture, if the patient is to be moved on his back. Preferably, in moving him to the stretcher, he is turned face down and picked up by the shoulders and thighs, so that the trunk is extended. (Fig. 4.) This position is maintained on the stretcher by pillows or blankets under the chest and shoulders and under the lower

pelvis and upper thighs, with the patient on his abdomen, thus continuing hyperextension of the lumbar region. No other

Fig. 3. If a patient with a thoracolumbar fracture dislocation is carried upward, the spine is forced into flexion and the injury must be increased. (From Fractures and Other Bone and Joint Injuries, by R. Watson-Jones, William Wood & Company, 1940.)

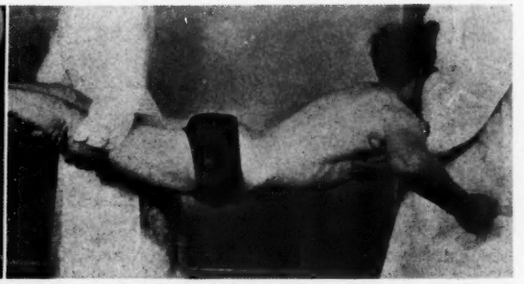

Fig. 4. When no stretcher is available, face down transportation is relatively safe. (From Fractures and Other Bone and Joint Injuries, by R. Watson-Jones, William Wood & Company, 1940.)

more cumbersome methods of splintage are needed.

II. MANAGEMENT AT HOSPITAL

The actual detailed treatment will, of course, vary with the individual case. General principles are:

A. Treatment of Shock. This includes further maintenance of body heat, removal of clothing without disturbing splintage (still leaving the shoe on in lower extremity cases), sedation with morphine, etc. If not already done, a traction splint is applied as soon as possible before *x*-raying in cases of long bone fractures. In addition, the shock position in bed, intravenous infusion and, in occasional cases, blood transfusion may be indicated depending on the extent and nature of associated injuries. The average patient with fracture of the shaft of a long bone, in a proper splint, arrives at the hospital in good condition.

B. Physical Examination. Definitive diagnosis must now be made and the sites of suspected lesions and proposed *x*-rays must be determined. Internal visceral, skull and urinary tract injuries must be looked for. It is unwise to attempt to elicit crepitus, false point of motion or other of the gross signs of fracture. It is sufficient to establish local bony pain, swelling or discoloration, related to an injury, to warrant prompt *x*-ray study for fracture. In these days of legal complications, insurance coverage, workmen's compensation laws and negligence suits, it is foolish to spare *x*-ray study of suspected bone lesions. Similarly, careful examination for soft part injuries, especially to nerves, tendons and blood vessels, must be made as a routine. In shoulder, humeral and knee fractures especially, nerve injuries must be sought. If a patient falls from a height on his feet, hard enough to fracture his heel, etc., always examine and *x*-ray the lumbar spine for vertebral compression.

C. Time Factor. The sooner reduction of a fracture is done, the easier it will be in general and the less trauma will be inflicted. Fractures requiring manipulative reduction especially, should be treated as soon as possible after entrance to the hospital, e.g., Colles' fracture, displaced ankle fractures, supracondylar humeral fractures, dislocations of all kinds, etc. While it is possible to reduce many of these after lapse of a night or longer, the swelling which supervenes obliterates landmarks and makes final splinting much more difficult even if reduction can be obtained. Long bones may be temporized with if maintained under strong traction in a Thomas splint without strangulation of the foot or hand by the encircling traction hitch. Fracture of the hip may likewise be delayed for a period of a few days in traction to see how the elderly patient will stand confinement in bed and the shock

of injury. Moreover, none of these fractures is so much of an emergency that a shocked patient with other injuries must be rushed through reduction. Rather than put up fractures without *x*-ray examination, almost any fracture can be deferred from a few hours to a day or so until transportation to a place where the proper two-plane study can be done.

D. Control of Infection: Compound Fractures. Tetanus antitoxin should be given in all cases (1500 to 3000 units intramuscularly). This should be repeated in ten to fourteen days if the wound is still a problem and was grossly contaminated. Patients with crushing injuries, extensive bruising and death of soft tissues, comminution of bone, soiling of the wound with street dirt or manure covered country soil, should be given in addition polyvalent, concentrated antigas serum intramuscularly. This will guard against gas bacillus and other anaerobic infections. Proper skin or eye tests for sensitivity to horse serum should always precede administration of these sera.

E. Decision on Operation. This should be made as soon as possible. An obviously small wound made by penetration of bone from within or by injury from without, treated early, under relatively clean circumstances, should be cleansed, the surrounding skin carefully shaved and cleansed to spare further contamination, washed with benzine, if necessary, to remove grease, followed by alcohol or ether and iodine and then a dry sterile dressing. The fracture is thereafter treated exactly as though it were a simple fracture. The skin of such punctured wounds should never be sutured. Small stab and gunshot wounds must be judged by the particular indications in the particular case. If it is difficult to determine connection of a small wound with bone, the presence of fat globules mixed with blood is in favor of a bony injury.

All other compound fractures demand surgical intervention as soon as possible, but never before recovery from the initial shock. These injuries may be classified as (Bohler): (1) Contaminated cases, those seen within four to six hours from the time of the injury, or in selected cases, up to twelve hours. (2) Infected cases, including all cases seen longer than twelve hours and usually longer than four to eight hours after the accident, as well as certain cases seen even earlier, and of course all cases with frank suppuration, gas infection, etc., already in evidence.

Detailed care of all types of compound fractures cannot be given in the brief space of this article. Certain principles only may be stated regarding their management. The limb is prepared in the splint so far as possible, avoiding further wound contamination in shaving, cleansing or too strong preliminary irrigation. The remainder of the preparation is done after anesthesia has been induced. Anesthesia is frequently local, infiltrating the area at a distance from the skin edges all around and underneath the wound and at the fracture site; many cases, of course, demand regional or general anesthesia.

Attempt is then made to excise completely all infected tissue, preserving as much skin as possible and paying especial attention to the skin edges, bruised and shredded fascia, muscle and soiled bone. Frequent changes of gloves and instruments are made as needed on proceeding into the wound depths. Thin, wide surfaces of muscle and actually contaminated bone edges, with perhaps ½ to 1 mm. of contused skin edge, are usually removed. Loose pieces of bone should never be discarded unless completely free of periosteum, fascia and muscle, as union may be jeopardized if too much is removed. After complete excision of the early, potentially infected cases, the skin is closed without drainage and with no deep sutures, except for possible nerve or arterial sutures. In the infected cases or those in which trauma was so extensive as to contraindicate such closure, the excised wound is packed wide open with vaseline gauze (Orr treatment) or iodoform gauze, or it is

Dakinized from the first. It is at this stage that 5 to 15 Gm. of sulfanilamide crystals (Jensen et al) may be placed in the wound to counteract invasion of streptococci and some other invading organisms including gas bacilli. This may be introduced into wounds which are to be closed or left open. According to Key and others, wound healing is unimpaired and infection is prevented. This form of therapy is still under investigation and is too recent to be used routinely.

No attempt is made to expose the bones extensively enough to perform internal reduction and fixation. Rather, after thorough debridement as has been described, the fracture is reduced as a closed fracture by manipulation or appropriate skeletal traction with application of a nonpadded plaster cast for more perfect immobilization wherever possible. Windows are cut in the cast only when fear of infection or constitutional reaction demand it.

F. Prophylactic Use of Sulfanilamide. In this form of treatment, moderate doses of sulfanilamide are given orally as a possible preventive of extensive infection in all sorts of traumatic wounds. This is receiving an extensive trial in the present war, especially in Great Britain (Whitby) but its efficacy has not been accurately determined. It would appear useful against the hemolytic streptococcus and gas bacillus but not against Staphylococcus aureus. Administration of this drug must be controlled by frequent clinical, blood and urine examinations to detect complications.

G. Definitive treatment is then undertaken as soon as feasible. Here, it must be emphasized that the patient must not be lost sight of in treating the fracture. Visceral injuries, chest complications or intracranial injuries may render fracture treatment of secondary importance. Primary operative treatment of simple fractures is often required in displaced fractures of the olecranon, patella, head of the radius, condylar fractures of the knee and elbow, cases in which a loose fragment prevents proper reduction or in which closed reduction allows too much persistent displacement with its promise of future deformity. Under favorable and aseptic operating conditions, with the modern use of vitallium materials for osteosynthesis, numerous fractures of both bones of the forearm, oblique fractures of tibia and fibula, intracapsular hip fractures, femoral shaft fractures and others are being treated by open reduction more often, as a matter of choice.

The final point to be emphasized is the medical and medicolegal necessity for postoperative and check-up x-ray studies. The need for these is obvious, but they are all too often neglected, with the result that negligence suits are not only started (which is sometimes unavoidable) but won. Every displaced or potentially displaced fracture should have an x-ray examination before attempt at reduction, immediately afterward to check reduction and at appropriate intervals thereafter.

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DISLOCATION OF THE SHOULDER

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THE correct handling of shoulder dislocations is of prime importance to the general practitioner. Usually he is the first to come in contact with this injury no matter whether he is situated in a small community or in a large metropolis. The proper recognition of this condition and its early reduction should not offer difficulty in general, but it is essential that the limitations of various methods of treatment in individual hands be kept in mind. Only by having adequate knowledge of the mechanics of the causative accident, of the pathology and of the relation of the important structures surrounding the injured joint may an excellent end result be obtained. Besides restoring the normal anatomic constitution of the joint without unduly traumatizing important structures, one must anticipate the prevention of recurrent dislocation which is a serious disability.

The patient may give the story of a heavy fall on the shoulder, on the outstretched arm or on the elbow. However, a strong pulling force exerted on the shoulder may be the causative factor. The dislocation usually occurs with the extremity in a position of moderate abduction and some degree of rotation. A fall on the arm would thus pry the head of the humerus out of the glenoid and through the weakest point of the capsule at its anterior inferior portion. It is here between the long head of the triceps posteriorly and the subscapularis anteriorly that the capsule is least protected by musculature. This factor also determines the frequency of anterior or subcoracoid dislocation as contrasted with the rarity of posterior dislocation.[20] Although most observers believe that the injury is caused by a leverage action on the humerus, it is also likely that direct trauma to the humeral head or along the shaft of the humerus will thrust the proximal end of this bone out of the glenoid.[1] This may be accomplished by a fall backward on the shoulder or on the tip of the posteriorly displaced elbow. Strong muscular action may be a definite factor in sliding the head of the humerus over the glenoid rim. Undoubtedly, dislocation caused by this latter mechanism can be produced only when there is a pre-existing defect of the shoulder either congenital or acquired. A shallow or partially deficient glenoid,[20] large or misshaped humeral head, relaxed capsule and muscular imbalance are all predisposing factors for dislocation.

Thus primary dislocation of the shoulder is caused by a more or less severe trauma and is accompanied by very characteristic and well known signs and symptoms. Severe pain and restriction of motion, flattening of the shoulder, apparent lengthening of the arm, flexion and internal rotation of the arm, inability to press the arm close to the side and prominence of the humeral head in the axilla are all indicative of this condition when all or a majority are observed. However, the examination is not complete unless an attempt is made to rule out motor or sensory changes as well as circulatory damage in the affected extremity. Various degrees of anesthesia or paralysis of the extremity may have been caused by tear or rupture of the brachial plexus or its peripheral branches at the time of the accident. Blood vessel injury may be a serious complication and the palpation of the radial pulse is a simple though efficient method of indicating the adequacy of the blood supply. In all cases it is extremely important to note these latter findings before an attempt is made at reduction. Fractures about the shoulder may be associated with dislocation in .5 to

22 per cent of the cases.[15,19] These may be avulsions of the tuberosities, fracture of the glenoid of the scapula or fracture of the neck of the humerus. They occur most often in individuals over 40 years of age and their coexistence definitely alters the prognosis.[5,12] Stereoscopic or anteroposterior and lateral *x*-rays of the shoulder are of value not only in establishing the diagnosis and ruling out fracture but also in helping to outline the course of treatment.

REDUCTION

Early reduction is essential here as in other dislocations. In very fresh cases seen within fifteen to thirty minutes following the accident, it may be possible to reposit the humeral head by gentle manipulation or traction and axillary pressure without anesthesia. However, it is safer to apply a temporary sling and to hospitalize the patient so that *x*-rays may be taken and the reduction accomplished under narcosis. The method of choice for reduction should depend on the experience of the operator. Nevertheless all methods are not infallible and several may have to be tried in order to succeed. The various maneuvers described in the literature depend on either leverage action, traction or their combination to replace the head of the humerus into the glenoid. Probably the Kocher method is the best known but the classical Hippocratic maneuver of traction and countertraction in some form, has been the one most extensively used. Even in the most expert hands these methods are not without failure and may be productive of serious trauma to axillary blood vessels and nerves. During recent years several maneuvers have been described which according to the authors are less traumatizing and very effective. Peterson[19] favors Zierold's method of controlled leverage in which the operator places his elbow in the patient's axilla and with the same hand holds the patient's forearm above the elbow. Thus traction can be applied while the arm is gradually abducted. Milch[14] employs gentle abduction and external rotation while holding the head of the humerus in the axilla so that it does not slip lower. He states that it is very efficient even with no anesthesia. Shumate[21] exerts traction on the affected extremity by means of a sling around the operator's back and shoulder and the patient's elbow. Pressure is applied against the side of the patient's chest while the surgeon's thumbs push up the head of the humerus. The older methods should not be discarded but the various other maneuvers should be kept in mind in case one fails. In all cases gentleness in the attempt at reduction will obviate undue and sometimes regretful complications. Persistent failure in reducing a given dislocation, especially one not seen early, warrants seeking expert assistance. Definite fibrosis and contracture may occur within two to three weeks making closed reduction difficult if not impossible.[2]

After having attained an appropriate reduction, retention of the extremity in a position most conducive to healing is an important part of the treatment. The injury must cause a joint relaxation whether by stretching or tear of the anterior portion of the capsule or by rupture of the anterior glenoid ligament. Immobilization by strapping the arm to the side in an attitude of adduction and internal rotation or in a Velpeau bandage must be sufficiently long to allow healing of the damaged capsule. Three weeks is not too long a period for this purpose. The importance of avoiding permanent relaxation of the capsule cannot be stressed too greatly in the prevention of recurrent dislocation. Active motion and exercises are then instituted to strengthen the shoulder musculature. Heat in its various forms will undoubtedly add to the patient's comfort and ease his attempted motions. Abduction should probably be restricted for several weeks but one will find that nature has already taken this safeguard as deltoid power is weakened and there may exist some moderate shoulder fibrosis. Circumduction of the arm, while the trunk is bent forward first without weight and later with the patient swinging two pounds,

is of value in restoring motion. Still later finger creeping up the wall with the extremity in abduction as well as pressing the hand sideways against the wall will improve deltoid function. It may be advisable to warn the patient to avoid strenuous use of the arm for a period of time but following proper care and the return of strong muscle power most patients may resume fairly active labor within six to eight weeks. In complicated dislocations the recovery period will naturally be of longer duration depending on the additional trauma. Fractures should be treated preferably by closed methods as the functional end result is usually better.[11] Fracture dislocations of the head of the humerus in older persons may require excision of the head of the humerus in order to avoid prolonged immobilization and yield a fairly well functioning shoulder devoid of pain. Aseptic necrosis of the head is occasionally seen in these cases and also may require excision.[12] Nerve injury may entail months of treatment for complete or even partial recovery.[13]

In old dislocations when closed reduction has failed, Bennett[2] advises open reposition of the head into the cleared glenoid fossa followed by a biceps tendon suspension and repair of the capsule. He reports satisfactory results from this procedure but believes that older individuals should be given conservative therapy especially if they regain 50 per cent of painless, free motion.

RECURRENCES

From a review of the literature it is apparently difficult to ascertain the percentage of recurrent dislocation of the shoulder following a primary injury. According to Henderson habitual dislocation which is a most disabling condition is rare.[7] In most cases the etiologic factor is severe trauma at the time of the first dislocation. The usual history also shows that the period of immobilization following reduction was either lacking or too short. Dislocations may recur infrequently following lesser grades of trauma or may be habitual and occur practically at the will of the patient. The shoulder may be dislocated when the patient moves about in bed in his sleep or in epileptics during a convulsion. As many as 100 consecutive dislocations have been recorded in an individual.[8] The recognized pathology is a weakness of the anterior inferior part of the capsule due to failure of healing of the original tear. Bankart believes that the head of the humerus shears off the fibrous or fibrocartilaginous glenoid ligament from its attachment to the bone and that there is no tendency whatsoever for healing.[1]

Kellogg Speed quoted by Codman[3] outlines the following causes of recurrent dislocation: (1) Defect in the head of the humerus acquired at the first dislocation or perhaps congenital; (2) shallowness of the glenoid following fracture or congenital; (3) rupture of the insertions of the external rotators of the head of the humerus; (4) avulsion of the tuberosities with or without rupture of the rotators; (5) detachment of the capsule from the anterior glenoid; (6) enlarged joint from a relaxed capsule following tears which have been given insufficient time for strong cicatrization or repeated stretching without tears; and (7) (Codman) incoordinated muscle pull from two opposing muscles.

Prevention of this condition is of importance in the treatment of primary dislocation as has been described. However, once it has occurred its control may be accomplished by conservative methods or by operative reconstruction. Codman[3] usually advises the patient to limit his activities and change his occupation. Davis believes in developing the shoulder musculature as well as aiding in the healing of the capsule in early cases.[4] Many operations have been devised for the correction of this condition. Each attempts to remedy an outstanding defect as listed in the aforementioned causes. Some try to deepen the glenoid (Hildebrand) by inserting a bone graft in its margin (Speed). Albee and MacAuslan repair the capsular relaxation while Gallie[6] makes a new inferior glenohumeral ligament with fascia lata. Hey Groves constructs a fascial sling under the

capsule and attaches it to the acromion above.[9] The Clairmont procedure depends on strengthening the capsular defect by the transference of a section of deltoid muscle as a sling across the weakened portion. Henderson uses a part of the tendon of the peroneus longus to suspend the head of the humerus to the acromion with excellent results.[7] Hobart advises the combination of the Clairmont and the Nicola operations.[10] Nicola has devised an operation which is fairly simple to perform and has been successful both for control of the disability and for return of good function not only in the hands of its originator but in general use, especially throughout this country. The tendon of the long head of the biceps brachii is passed through a tunnel gouged in the head of the humerus and resutured to itself in order to suspend the humerus. The head of the humerus is thus actually attached to the glenoid by a newly formed, stout ligament and cannot slip out of the joint.[17,18] Other advantages of this procedure with which we have had some experience are that active motion may be begun in three weeks and that this procedure is indicated no matter what defect is causing recurrence of dislocation.[16] Nicola reports practically no restriction of motion and no recurrences in thirty-two of his patients after a follow-up of several years.[17]

SUMMARY

1. Early recognition and treatment of shoulder dislocations is essential.

2. A knowledge of the mechanism of the accident and of the pathology is of value in the treatment of these cases.

3. Fractures and blood vessel and nerve injuries should be searched for before attempting reduction.

4. Adequate protection after reduction is necessary to facilitate healing of the damaged capsule. This will help prevent recurrent dislocation.

5. Several operations are advocated for control of habitual dislocation.

6. The Nicola operation seems to enjoy general use and approval in this country. It can be performed by the average surgeon and if done correctly will yield excellent results.

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TRAUMATIC DISLOCATIONS OF THE HIP JOINT*

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TRAUMATIC dislocations of the hip joint comprise a very small percentage of all dislocations. These are estimated at from 2 to 5 per cent by different authors. The incidence has increased in recent years because of severe trauma sustained in automobile accidents, hence the term "dash board dislocation." In these cases the most common cause of dislocation is a severe blow on the flexed knee against the rear seat or dash of the car while the patient is sitting with hips flexed. The force transmitted from the knee to the hip forces the femoral head from the acetabulum, usually in a backward direction.

Dislocations are classified as anterior or posterior, in regard to their relation to Nelaton's line which bisects the acetabulum, and furthermore, as high or low depending on the final resting place of the dislocated head. Posterior positions are seven times more frequent than anterior positions. This is due (1) to the weaker posterior hip capsule, (2) to the fact that the most frequent force applied is to the hip in a flexed position and in a backward direction, and (3) to the stability of the hip which is at its minimum when in this flexed position. Any trauma which approximates the knee and pelvis may produce a posterior dislocation. Anterior dislocations usually result from forceful abduction with or without external rotation. In these motions the head is pried from within the acetabulum and is forced through the capsule anteriorly.

In all dislocations, whether anterior or posterior, there is usually considerable shock in view of the trauma to the soft parts and the frequency of fracture of the acetabular rim. The ligamentum teres is always torn and also the capsule. When the head passes through the capsule posteriorly, there is injury to the short external rotators and the sciatic nerve may be traumatized. When the head comes forward through the anterior capsule, the adductors and obturator internus muscle are prone to injury.

DIAGNOSIS

The diagnosis of a posterior dislocation is based on the following findings: With a history of recent severe injury the patient presents an acutely painful hip on which he is unable to bear weight. The characteristic position is that of flexion, adduction and internal rotation. This position is relatively fixed and cannot be altered actively. The extremity is shortened, though the apparent shortening is greater than the real shortening. The tip of the great trochanter is above Nelaton's line and the buttock on the affected side is prominent due to the presence of the dislocated head beneath the glutei. Although motion is markedly restricted, it may be possible to move the hip in the direction of the existing deformity, that is, in flexion, adduction and internal rotation. External rotation, abduction and extension are impossible because of the tense Y ligament on the anterior aspect of the joint. This ligament is very rarely torn and then the limb will fall into an everted position rather than remain in internal rotation. The high type is much more common than the low. Except for the fact that in the low type there is a greater degree of flexion deformity present, the above is applicable in diagnosing both types.

Diagnostic signs of an anterior dislocation are quite the opposite from those of the posterior type. There is usually a

* From the Orthopedic Service of Bellevue Hospital, Arthur Krida, M.D., Director.

history of a forceful spreading apart of the lower extremities. The involved extremity is maintained in external rotation and abduction. There may be slight flexion or extension. The trochanter is depressed and the lateral aspect of the hip is flattened. The head of the femur may be palpated in Scarpa's triangle or in the adductor region. Goetz has reported a case in which the head came to rest within the scrotum. In this case the abduction deformity was beyond 90 degrees and there was marked internal rotation, probably because the head had passed below the

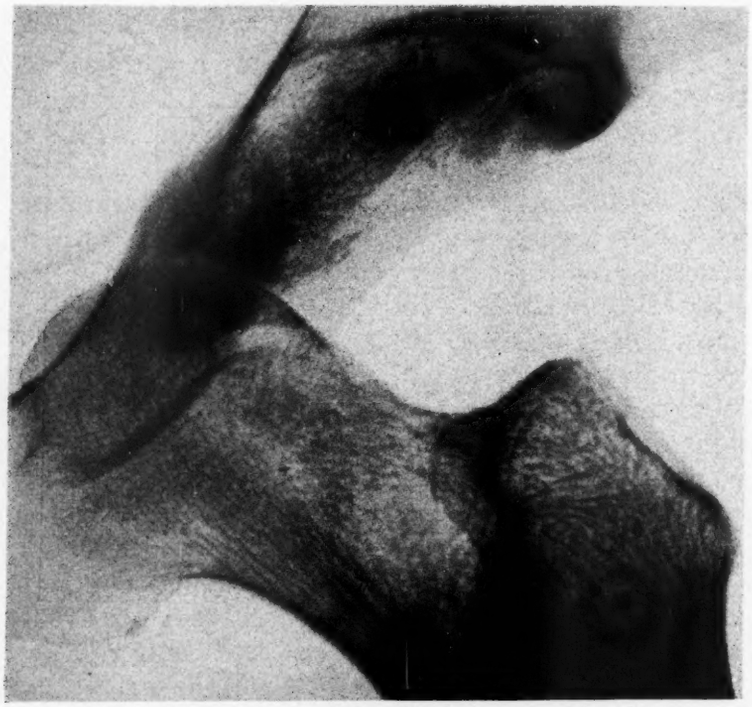

FIG. 1. Low anterior dislocation in 23 year old male.

FIG. 2. One month after reduction. Note early necrosis of head at central portion; wedge-shaped area of destruction.

pubis and had no support. The high type of anterior dislocation is more common than the low. Usually the lower the head is displaced the greater is the abduction deformity. In all cases there is some actual shortening, but because of the abduction deformity there is apparent lengthening of the limb. Internal rotation and adduction are markedly limited or absent, whereas external rotation and abduction may be increased.

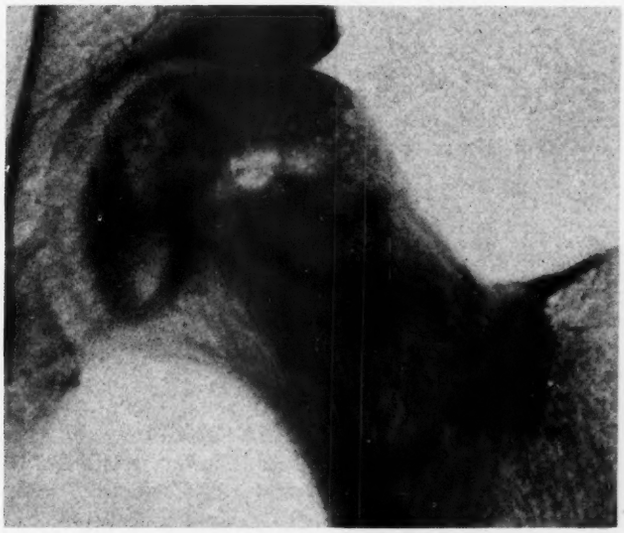

Fig. 3. After two years. Flattened head; narrowed joint space; areas of increased density surrounding areas of decreased density.

TREATMENT

Returning the dislocated head into the acetabulum and maintaining it there is the primary consideration in treatment. Since delay renders reduction more difficult, it should be done as soon as possible. Because of the powerful musculature about the hip a general anesthetic is essential to secure relaxation.

During any manipulative procedure it should be kept in mind that the sole object is to return the head to its socket along the path it traveled while dislocating and to do this with the least possible trauma to the badly injured soft parts. It must be disengaged from these soft parts and returned to the acetabulum through the original tear in the capsule. In all methods of reduction, flexion of the thigh to about 90 degrees in order to relax the Y ligament and to bring the head opposite the tear in the capsule is an essential point.

In posterior dislocations there are three methods of reduction in common use, namely, Allis', Bigelow's and Stimson's.

Allis' method is primarily that of traction and countertraction of the flexed thigh against the pelvis. The patient is placed on the floor, the pelvis held down firmly by pressure over the iliac crests by an assistant or by a strap; the thigh and leg are flexed at right angles and then strong, continuous traction is made on the thigh grasped just above the knee. Bohler modifies this method by using a towel applied around the thigh, above the knee and then tied around the operator's neck. From a kneeling position the operator exerts a strong upward pull by straightening his back. At the same time downward pressure is exerted on the foot in order to produce leverage over the surgeon's knee which is placed in the popliteal region of the patient. Bohler reports complete success with this method in all types of dislocations. If resistance is encountered in using this method gentle manipulation to disengage the head should be carried out. Adduction and internal rotation should be increased.

The method of Bigelow is more fraught with danger of injury to soft tissues inasmuch as it is essentially manipulative in character. The pelvis is immobilized and the thigh is rotated internally, adducted and flexed on the abdomen. In this position traction is exerted on the thigh in an upward direction and then the limb is slowly circumducted, that is, swept out into abduction and then into extension. As it is abducted, it is externally rotated. The first maneuver relaxes the Y ligament and brings the head down to the level of the tear in the capsule. In this position traction pulls the head up on the posterior rim of the acetabulum; then abduction and external rotation pry it forward into the acetabulum.

The Stimson method is probably the least traumatizing. The patient is placed on the table in the prone position projecting over the end and allowing the affected thigh to hang down. The other thigh is supported by an assistant. In this position gentle downward traction with slight rotation and rocking will usually effect reduction.

The rarer anterior dislocations are reduced by Allis' method as follows: The thigh is flexed slightly and the abduction deformity and external rotation are increased. Then direct traction is exerted on the thigh. These maneuvers lift the head away from the pelvis. With traction maintained, the thigh is gently adducted and internally rotated to bring the head over the rim and into the acetabulum. As has been stated, Bohler uses traction satisfactorily on the thigh flexed to 90 degrees in all types of dislocations.

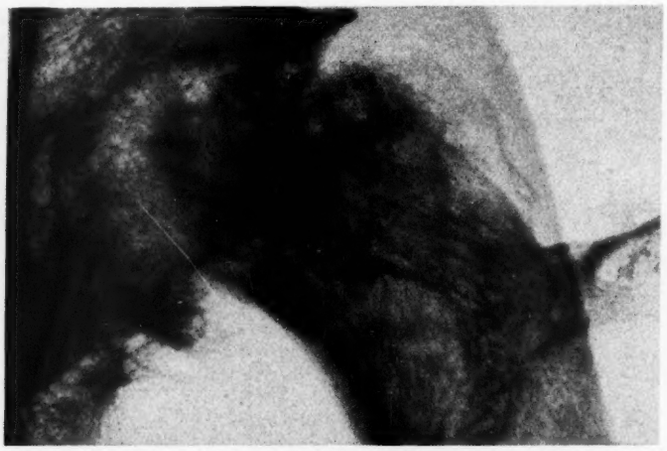

FIG. 4. Flattening of head increased. Shows necessity for long period of nonweight-bearing.

The treatment of reduced cases is at first concerned with prevention of recurrence. Those of the posterior type must be protected against flexion and adduction; those of the anterior type against abduction and external rotation. Bed rest from three to six weeks with or without plaster immobilization is usually recommended. Then weight bearing with the use of crutches is allowed.

Although most textbooks fail to mention aseptic necrosis of the femoral head as a sequela of traumatic dislocation, its importance and frequent occurrence has been noted within recent years. Bergmann, in 1931, was one of the first to note and report such a case. Stewart, in 1933, reported the first case in America. Funsten, Kinser and Frankel in reviewing twenty cases of dislocation in 1938 noted necrotic changes in the head in the follow-up of six cases. This report emphasizes the frequent occurrence of these late changes which in the past were undoubtedly considered as traumatic arthritis.

In 1939, Potts and Obletz reported five cases and Kleinberg two. Phemister, and Chandler and Kreuscher have also reported

such cases. At Bellevue Hospital, we have operated upon one patient who presented a typical case. In view of the relative infrequency of hip dislocations, the number of reported cases of aseptic necrosis of the head signifies that its occurrence is not infrequent.

Necrosis of the head following dislocation is due to a loss of blood supply to a part or all of the head. The blood supply of the head is derived from vessels in the neck, the ligamentum teres and the capsule. Tearing of the capsule and rupture of the ligament deprive the head of a great part of its circulation and the extent of the necrosis depends upon the degree of loss of blood supply. Because of this, Phemister and Kleinberg have cautioned regarding manipulation. Gentleness in reduction lessens damage to injured vessels and thereby lessens the possibility of aseptic necrosis. They have also emphasized the importance of protection of dislocated hips from weight bearing for long periods in order to allow revascularization of necrotic areas and the replacement of necrotic bone by new bone (creeping substitution). The anticipated flattened deformity is thereby reduced to a minimum or prevented. Kleinberg advises the wearing of a long Thomas walking caliper brace for one year.

The clinical symptoms of necrosis are pain and stiffness of the joint coming on a few months after reduction. These symptoms increase, a limp becomes noticeable and a flexion adduction deformity develops. No appreciable actual shortening is present.

Other sequelae are (1) myositis ossificans of the torn capsule, which may cause pain and stiffness of the joint and necessitate operative treatment, and (2) persistent nerve injuries. Muscle injuries do not demand special care and cause no sequelae. Fractures of the acetabular rim may demand operative treatment at the time of dislocation or at a later date. Fragments causing limitation of motion should be removed.*

SUMMARY

1. The incidence, classification, mechanics of production, diagnosis and methods of reduction of traumatic dislocations of the hip have been reviewed.

2. The occurrence and frequency of aseptic necrosis of the femoral head after reduction has been emphasized.

3. Protection from weight bearing by means of a brace for a long period to permit substitution of necrotic bone by new bone and the prevention of deformity of the head are essential.

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* The illustrations are *x*-rays of a case reported in an article by Axhausen and Bergmann in 1937 and are presented by courtesy of the latter.

THE USE OF PLASTER

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A PLASTER of paris dressing applied to a limb or portion of the body which does not function other than to cover the part is entirely without virtue as a surgical appliance. On the other hand, there is no satisfactory all around substitute for this material for the execution of splintage problems, small or large, simple or complex.

Think of the newborn infant who for the first months must have properly applied forces to correct the resistant deformity of a club foot, and that these forces are applied continuously and progressively up to the pressure tolerance of the delicate skin and underlying soft parts.

Think of the 200 pound adult who must have one or both lower extremities immobilized and anchored to his trunk for several months. Both of these problems can be solved best by the use of plaster of paris. In order to prevent delay and skin damage in the infant, and to assure comparative comfort and lasting efficiency in the 200 pound adult, not only the application of the appropriate size and number of bandages, but their application with proper care and thoughtfulness are absolute requisites.

Plaster of paris has been widely used as a splintage material since Matthysen, a Dutch Army Medical Officer, published a pamphlet on its uses in the treatment of fractures in 1852.

For the average user, plaster of paris bandages are available in the usual sizes—2, 3, 4 and 6 inch widths—and in various setting times—slow, fast and specially fast. These bandages are prepared by several well known manufacturers and are of dependable standards. They come boxed in moisture proof containers and should be stored without altering this factor.

For frequent users, home made bandages are less expensive but care and experience are necessary to produce good ones. The cloth portion (crinoline) of the bandage is of a stiff meshed material, sized with a substance which will not interfere with proper setting and drying of the plaster of paris. The mesh should be of sufficient size to permit plenty of plaster to be rubbed into its surfaces. Two meshes of crinoline are available for use; the best 32 by 28 mesh, and the next best 28 by 24 mesh. The latter is less expensive but makes satisfactory bandages. The plaster portion of the bandage is of the finest grade plaster of paris known usually as "dental," "surgical," or "orthopedic" plaster and comes packed in 100 pound moisture resistant bags or in 250 pound barrels. These containers give adequate protection from moisture, if stored in a dry place, for eight to twelve months. In making the bandages the crinoline is torn into strips of the desired width and cut into proper lengths—2 inches by 3 yards, 3 inches by 3 yards, and 4 and 6 inches by 5 yards.

The plaster is rubbed thoroughly into the meshes of the crinoline and the bandage rolled firmly but not tightly. Care in handling so as not to dislodge the plaster obtains at all times and is more to the point than wrapping each bandage in paper for this purpose. Straight splints can be made and stored as such by reversing a given length of bandage on itself a number of times.

Immersing the bandages at the time of their use is of the utmost importance. A sizable container of water is necessary (12 quart pail). Changing to fresh water as plaster saturation takes place is absolutely essential. Agents in the water to accelerate drying, such as salt or sugar, are unneces-

sary. Bandages are gently placed on end in the water about one minute before the surgeon is ready for it. After the bubbles have ceased to rise, indicating wetting of all layers, the bandage is grasped with both hands; the palm of each hand is held firmly against the ends of the roll. When free of the water, the roll is squeezed with a twisting motion, then straightened or untwisted with the palm of the hand held firmly against the ends. At this stage the bandage should not be wet enough to drip.

In the application of a large plaster dressing, such as a jacket or spica, it is important not to permit too much drying between layers, so that the entire thickness is one of amalgamated strength and not several layers of dry cleavage planes between.

Strength results with proper application and rubbing of each turn into the previous one. Lightness also results because less material is needed.

PREPARATION OF THE PART FOR APPLICATION OF THE PLASTER

Proper application of the under dressing is of no less importance than the outer shell of gypsum. An excellent covering for the skin, form fitting and easily applied, is a stretchable cotton material called stockinette. It is knit as a circular tube and comes in diameters of 3, 6 and 11 inches so that a piece of appropriate length can be cut and pulled over the part to be encased with the bandage. Several inches of extra length are left to be pulled back over the ends of the cast and anchored with the last turn or two of the plaster bandage. This makes a neatly finished end and helps prevent irritation of the skin.

Sheet wadding is a thin sheeting of nonabsorbent cotton with a thin, hard finish of starch. It is sold in 36 inch widths 6 yards long. From this bandage rolls of different widths are made. These rolls should be not greater in diameter than can be easily held in the hand. Large thick rolls are cumbersome and difficult to apply. The number of layers one uses for padding varies with the cast at hand and the part to be padded. In general two layers of sheet wadding make sufficient padding, but over the heel, sacrum and the anterior bony prominences of the pelvis several additional layers are necessary. A number of extra turns about the lower thorax, when encasing the trunk as part of a body spica, are absolutely essential for the patient's comfort. In applying a body jacket a square pad of four to six layers over the epigastrium will be appreciated by the patient at mealtime, as this pad can be removed after drying of the jacket, and thus allow for expansion of the abdomen.

Felt. White or gray felt about one-fourth inch thick and weighing slightly over two pounds per square yard, is a serviceable stock material to use as additional padding. It is extremely useful in very thin or elderly subjects in whom bony prominences demand the greatest consideration. In the aged, pressure necrosis will occur over night without proper padding.

Casts. These are built by circular bandaging of the properly padded part. The bandages are applied smoothly; each turn is pulled firmly but without constriction or roping of the bandage. Each turn is rubbed into the one beneath and support, if needed beneath the part being bandaged, is supplied by the palm of the hand instead of the fingers, which leave indentations. The attitude or desired position of a limb is obtained before any dressings are applied and is then maintained throughout the application of the padding and the overcoating of plaster, so that no wrinkles are formed by changing the position during the setting process. With experience one learns to utilize the small, final molding possibilities during the setting period.

Nonpadded casts or semipadded casts (over thin flannel bandages) are very useful for light weight, efficient splinting of certain joints, such as the wrist and knee. Their routine use in acute fractures should be left to those thoroughly trained in their application.

Splints. Plaster of paris lends itself admirably to custom or tailored splints. There are two very satisfactory ways of making these: (1) Applying a lightly padded, circular bandage, which after drying twenty-four to forty-eight hours can be bivalved and the best suited half retained as a splint. (2) Molding to the anterior or posterior surface of the part to be splinted, a plaster reverse of appropriate size and thickness by a circular, flannel bandage. After setting ten to twenty minutes remove the bandage as a mold and allow it to dry over night. It can then be bandaged on in the regular way and removed as often as the case demands.

Reinforcement Splints. Often the incorporation of a plaster reverse in the outer layers of a regular or compression bandage will be very helpful for immobilization where surgical or bulky dressings are necessary.

Emergency Splints. The specially fast setting plaster makes an excellent temporary splint for transportation of fractures or dislocations. Here reverses are applied to the available or exposed surface of the part and held in place by circular flannel or gauze bandages. Setting takes place rapidly and after a short period of drying the patient can be moved with comfort and safety.

Jackets and Corsets. For support of the trunk alone, or as the foundation of a support to the head and neck, a plaster jacket properly applied has no equal. A removable corset can be made by splitting the jacket down the front immediately after setting, springing it off and after thorough drying it can be covered with stockinette and hooks and lacing sewn to each edge of the split front.

IMPRESSIONS AND CASTINGS OF POSITIVE REPRODUCTIONS

In the construction of certain more permanent types of form-fitting appliances of metal, celluloid and leather, there is no better model than the positive reproduction in casting plaster of the limb or trunk in question. A satisfactory impression or mold can be made of the part by using fast setting plaster of paris bandages, which then are removed, reassembled for proper contours, and filled with casting plaster. This model then serves the brace maker with an accurate reproduction of the part.

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Atkinson, Edward W. Plaster Casts—Their Preparation in the Hospital. Norwood, Mass., 1937. Plimpton Press.

PARONYCHIA AND BONE FELON*

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PARONYCHIA or "run around," as it is frequently called by the laity, is the most common infection involving the hand. This infection presents many varied manifestations, for the clinical appearance is determined by the duration and severity of the infection. It is commonly initiated by the occurrence of an infection in a so-called hangnail or a split in the eponychium. Any infected hangnail to all intents and purposes is a paronychia; however, many hangnail infections subside without giving rise to the cardinal signs of a paronychial infection. An acute infection may occur on the side of a nail with early formation of abscess with or without evidence of a hangnail. (Fig. 1*a*.) If this process continues unabated, the base of the nail becomes involved and characteristic redness and rounded swelling appear. In this early acute stage the pain is severe, but it subsides with drainage of the abscess which in turn results in the subsidence of the inflammatory process. Again, a seemingly associated acute infection of the side of the nail and a true infection of the base may arise simultaneously. The prognosis in this latter type of infection is not as good as in infections of the side of the nail treated early; however, if localization with formation of an abscess occurs in the involved side the general involvement of the finger subsides gradually.

There is still another type of paronychial infection, an indolent form, which may be the residual of the acute infection at the side of the nail or the condition may be indolent from the time of its inception with or without evidence of an infection at the side of the nail. In this group of infections, which are usually easily recognized, the period of healing may cover several weeks. There is swelling and redness at the base of the nail with little or no associated pain. During the course of the indolent infection a small amount of drainage gradually occurs which may be expressed by pressure on the eponychium.

In time, the nail root becomes yellowish and free from its attachment. At this stage an abundance of granulation tissue resulting from proliferation of the radix may appear. (Fig. 1*b*.)

In the treatment of paronychial infections, no set procedure can be established. The treatment depends on the extent of the infection and the stage of the involvement. For infection on the side of the nail warm, moist packs preferably of a 50 per cent solution of alcohol should be employed in an attempt to produce localization of the infection. When available, roentgen therapy is believed to be of definite benefit. When abscess occurs, drainage is best established by complete removal of the necrotic skin which forms the dome of the abscess; this procedure prevents the infolding of the edges of the skin which is a barrier to drainage. This type of infection usually is self-limited and runs its course over a period of a few days. If the infection should extend to the base of the nail, the process may be benefited by gently pushing back the eponychium and applying a 10 per cent solution of silver nitrate. The process may then subside without drainage and its course gradually terminate. Roentgen therapy is found to be of value, particularly if used in the early stage of the infection. If the condition becomes chronic and pus is found under the overhanging edge of the nail and the nail root becomes elevated, the establishment of

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drainage becomes necessary. This may be done by gently pressing back the eponychium and removing a portion of the overhanging nail root without injury to the radix and the cuticle. If the purulent material has extended completely across the base of the nail, it may be necessary to remove the entire base of the nail. This, however, can be done without resorting to a radical surgical procedure which is so frequently advocated in the textbooks such as a double incision, one incision being placed on each side of the base of the nail; the base of the nail is then elevated and removed.

FIG. 1. Appearance of infection: *a*, acute infection at the side of the nail; *b*, chronic paronychial infection of three weeks' duration.

In chronic infections, if the drainage becomes seropurulent and healing is slow, the chance that a portion of the dead nail root remains and is acting in the capacity of a foreign body should be considered. If this is the case and the portion of the dead nail root is removed, the drainage will subside. Treatment after removal of this remaining portion of the dead nail root, should consist of elevation and the application of warm, moist dressings preferably moistened with a 50 per cent solution of alcohol. When the acute process has subsided, light treatments should be employed several hours daily to promote absorption and lessening of the edema.

BONE FELON

"Bone felon" is the term employed to denote an osteomyelitis of the terminal phalanx of a finger. The occurrence of bone felons may be attributed to the anatomic construction of the soft tissue over the distal phalanx, in that the connective tissue framework produces a closed space. Kanavel called attention to the fact that the blood vessels run parallel to the phalanx on both sides through these closed spaces. With the occurrence of an infection avenues of escape are lacking and the edema and inflammatory process produce circulatory embarrassment with resulting bony necrosis. The epiphysis of children receives its blood supply before the vessels enter the closed space and it is therefore uninvolved in the primary process and usually remains intact.

At the onset of bone felon a sticking, sharp pain appears in the distal phalanx; this usually follows a puncture wound or trauma but occasionally a cause cannot be elicited. The process increases rapidly, and swelling, heat, localized tenderness and excruciating pain are produced. The pain is constant, boring in character, and at times difficult to relieve even with morphine. The systemic reaction usually is mild although there may be slight to moderate elevation of the temperature. The edema present produces a tenseness of the distal phalanx with drum-like stretching of the skin and associated pallor. On close inspection a central bluish portion frequently may be seen which is the result of deep hemorrhage and necrosis. If allowed to progress, the tenseness is soon replaced by a board-like hardness and in time by fluctuation with necrosis of the tissue and frank formation of pus. When destruction

of tissue and formation of abscess appear, the tension is released and the sensitiveness disappears. At this period there is bony involvement and, regardless of the treatment instituted, there is rapid destruction of the phalanx. Roentgenologic examination in the early stages does not reveal any abnormality, but when bony involvement occurs, a fuzziness may be noted on the palmar aspect of the phalanx in its middle or distal thirds. Destructive changes take place within a few days and, as early as a week to ten days after onset of symptoms, marked destructive changes may be noted. (Figs. 2 and 3.)

Fig. 2. Bone changes noted ten days after onset; treatment consisted of late incision and drainage. Anteroposterior and lateral views.

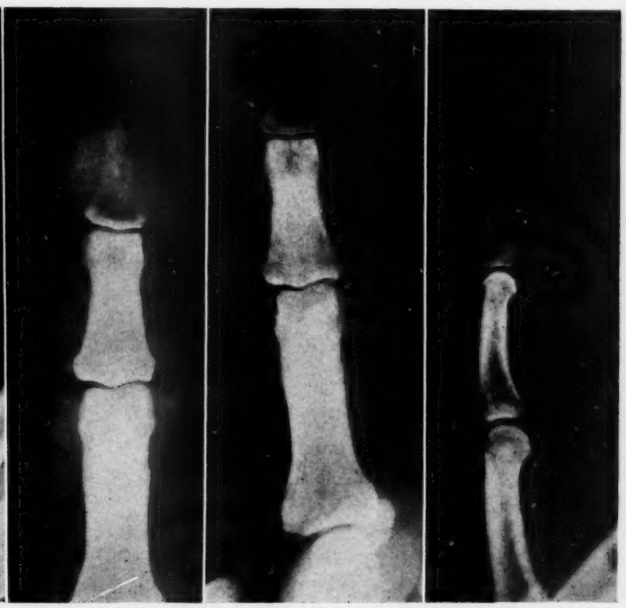

Fig. 3. Bone changes four weeks after onset. Absorption of distal three-fifths of the phalanx may be noted. Anteroposterior and lateral views.

To make a definite diagnosis of bone felon the condition should be distinguished from tenosynovitis, lymphangitis and subepithelial abscess. In infections of the tendon sheath the finger usually is held in a flexed position and the whole finger is enlarged symmetrically. On attempting extension there is severe pain and on palpation, tenderness extends proximally over the course of the tendon sheath. There is an absence of the excruciating, continuous pain and the exquisite localized tenderness found in the presence of a bone felon.

Lymphangitis at its beginning may simulate a bone felon in that pain and swelling occur in the finger but, usually, by the time these infections come to the attention of the physician, the diagnosis is established by the appearance of the dorsum of the fingers and hand. This type of infection is evidenced by characteristic red streaks. The swelling is also more extensive and there is an absence of the localized swelling of the distal phalanx and the extreme localized pain noted in bone felons. In lymphangitis the finger can be moved with relatively little or no pain.

Subepithelial abscess over the distal phalanx may in its inception simulate a beginning bone felon. This lesion presents a small area of redness, slight swelling and tenderness. There is, however, an absence of the characteristic continuous pain and tension of the ball of the distal phalanx seen in felons. There is an early localization of the infection with superficial formation of abscess readily seen beneath the skin.

The diagnosis of bone felon should be made early so that adequate treatment may be instituted. The treatment consists

of early surgical incision for release of the tension and the promotion of drainage in the closed space. The incision is best placed at the side of the phalanx; care should be bone. The finger should be placed on a splint for protection and comfort until the phalanx has completely reformed or is self-terminated.

FIG. 4. Same case as Figures 2 and 3; phalangeal reformation eight weeks after onset. Anteroposterior and lateral views.

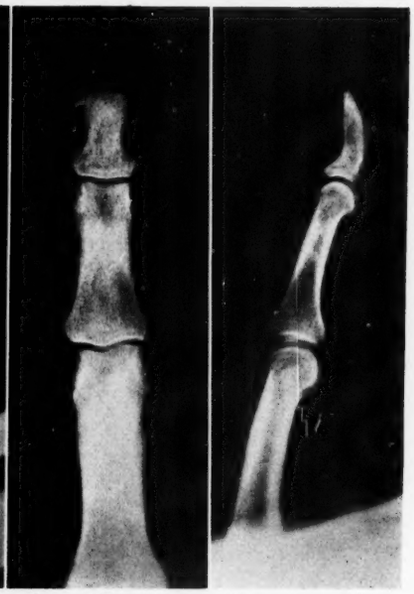

FIG. 5. One year after onset the phalanx is completely restored. Anteroposterior and lateral views.

taken not to extend the incision into the joint or to penetrate the attachment of the flexor tendons at the base of the phalanx. Midline incisions should be avoided, thereby lessening the chance of a sensitive, adherent scar in the tactile portion of the finger. The fish-mouth incision advocated by some is unnecessary and may complicate the healing and the function in the finger. Bone felons in the late stage of the infection which is often seen may rupture spontaneously and the problem is to determine if the drainage is adequate and if a sequestrectomy is indicated. If the question arises as to the proper procedure, maintenance of drainage through the opening which is already present is preferable to unwise surgical interference. In this stage the phalanx is certain to proceed to almost complete dissolution or sequestration. Every attempt should be made to protect the periosteum for reformation of the bone and even self-extrusion is more desirable than rough removal of incompletely sequestrated

Preoperative and postoperative treatment should consist of warm, moist packs preferably of a 50 per cent solution of alcohol, complete rest in bed with elevation of the hand and sedatives as indicated. When the acute inflammatory process subsides, daily hand baths in sterile saline solution and the employment of light (60 watt nonfrosted bulb) for periods of several hours daily promote absorption and hasten the healing. The use of sulfanilamide and its associated drugs may be of some benefit postoperatively, but because of the anatomy of the part they offer little in preoperative treatment. Although early incision is advocated, hasty incisions should be avoided. Also, whereas early incision offers the best results and early relief of pain, the results obtained with spontaneous or late drainage compare favorably with those in cases in which the patient is seen in the first stages of the infection and adequately treated by incision.

It is well to remember how surprisingly good the end results may be despite what apparently is a total destruction of the phalanx and endless days of drainage. The course in the majority of cases of these infections is one extending over a period of weeks with slow healing and regeneration of new bone. (Figs. 4 and 5.) Amputation is rarely if ever indicated and should be considered only in those cases in which there is an associated infection in the joint.

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Achondroplasia . . . is a curious congenital condition, somewhat resembling rickets, in which the growth of those bones developing from cartilage is cut short and interfered with by virtue of premature synostosis with the epiphysis.
From—"Rose & Carless Manual of Surgery," Edited by William T. Coughlin (The Williams & Wilkins Company).

TREATMENT OF FRACTURES OF THE CLAVICLE, RIBS AND SCAPULA*

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FRACTURES OF THE CLAVICLE

EIGHT to ten per cent of all fractures occur in the clavicle, and probably there is no other bone the fracture of which causes less permanent disability, severe complications or deformity. A confusing array of mechanical devices for fixation have been described, and it is our object to outline a method of treatment which can be carried out utilizing the simplest of surgical supplies.

The clavicle is ossified at birth save for the two extremities, and this probably accounts for the high frequency of fracture in childhood and adolescence. The fracture usually occurs in the middle third of the bone. The inner fragment is displaced slightly upward by the attachment of the sternocleidomastoid muscle. Unopposed by the strut-like support afforded by the intact clavicle, the pull of the pectoral and scapular muscles, plus the weight of the arm, cause the outer fragment to become displaced distally and inward. Fractures of the outer and inner quarters of the bone are rare and usually show very slight displacement.

Diagnosis. Because of the palpable deformity and the sensation of grating in the clavicular region, the diagnosis of "broken collar bone" is frequently made by the patient. In most instances an almost pathognomonic attitude is assumed—the head is inclined toward the injured side, the elbow is supported by the opposite hand and the shoulder on the injured side is visibly depressed.

The fracture is frequently overlooked in infants but should be suspected if following known or possible trauma the child cries on moving the arm or shows a disinclination to use the extremity. Careful palpation will reveal a tender spot along the clavicular line or demonstrable deformity. Roentgenograms should never be omitted.

Treatment. The object of any type of fixation is to hold the shoulder backward and upward. There is considerable difficulty in maintaining this position, and after having tried several methods we doubt that any one method will maintain anatomic reposition or result in union without some thickening at the fracture site. In most instances postreduction roentgenograms are very disappointing because very little change in the position of the fragments has been accomplished, but thickening due to incomplete reduction disappears within a relatively short time. Any method of treatment which immobilizes the shoulder, wrist or hand is to be condemned, especially in individuals over 40 because the resultant periarticular adhesions may cause permanent crippling. The ideal method of treatment must, therefore, be one which requires a modest armamentarium, is easy of execution and allows free motion of the shoulder, elbow and wrist. The clavicular cross and its various modifications meet these requirements but it has the disadvantages of being bulky and tending to become displaced. We find that 97 per cent of all clavicular fractures can be satisfactorily treated by the figure-of-eight bandage method, provided that the bandage is carefully applied with especial attention being given to adequate axillary padding.

Anesthesia is obtained by means of 2 per cent novocaine injected into the fracture site. The patient is seated upon a low stool. Both shoulders are then drawn backwards,

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the operator placing his knee in the middle of the patient's back for counter traction if necessary. A well beveled felt pad is then terminal portion is fastened in the interscapular region with large safety pins which are then covered with adhesive.

FIG. 1. The axillary pads are in place and the beveled compression pad is over the mesial clavicular fragment.

FIG. 2. Rear view.

FIG. 3. Figure-of-eight bandage has been applied and is held in place by adhesive strapping which encircles the chest.

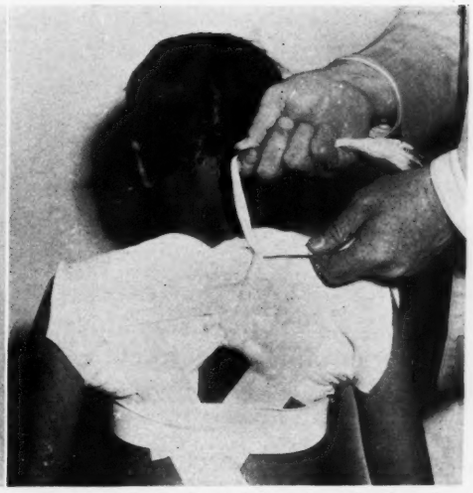

FIG. 4. Method of tightening the bandage by means of muslin strip.

placed over the mesial fragment and held snugly in place by means of a wide strip of adhesive. Carefully fitted felt pads are then placed in the axillae, especial care being taken to cover both anterior and posterior folds. (Figs. 1 and 2.) The pads should be of the softest saddle-maker's felt and about one-fourth inch in thickness. The figure-of-eight is now applied and with each turn of the bandage an attempt is made to pull the shoulders upward and backward and the

The bandage employed is the type which is usually known as neurological roll, is five yards in length and consists of four layers of gauze folded in tubular shape. This particular type of dressing is marketed by various supply houses. The dressing has a tendency to slip up toward the neck, and this is prevented by wide adhesive retention straps over each shoulder which are held in place by a third strip which encircles the chest. (Fig. 3.) Beneath the

central portion of the figure-of-eight posteriorly is placed a strip of two inch muslin which may be tied and tightened as the dressing tends to loosen. (Fig. 4.) A triangular sling supports the arm for the first few days. The figure-of-eight remains in place until there is evidence of union—usually three weeks—but it may be changed if the axillary skin shows signs of irritation. The patient is cautioned to watch for any signs of circulatory disturbances or evidence of nerve pressure and to report them immediately. If the pressure of the bandage causes discomfort for the first day or two, relief is usually obtained by having the patient lie on his back with the arms moderately abducted.

Nonunion almost never occurs and if it does the disability is usually negligible. A great many authors describe brachial plexus injuries occurring as the result of pressure caused by displacement of fragments and open reduction is advised. In our experience there have been two patients so treated who showed no improvement after open replacement of the comminuted fragment, and we are of the opinion that these nerve lesions are the direct result of the original trauma's tearing the primary nerve roots and not the result of pressure by displaced bone fragments.

The recumbent method with lateral traction on the arm is advised in compound fractures, in cases showing marked comminution and in those individuals in whom the figure-of-eight dressing proves especially irksome and who can economically afford the required three to four weeks in bed. A very simple apparatus can be arranged at the patient's bedside. (Fig. 5.) Through the medium of adhesive traction straps applied to the forearm and arm the extremity is suspended with the arm abducted 90 degrees and externally rotated 90 degrees. Five to eight pounds of traction on the arm is adequate and just enough weight on the forearm to hold it upright. After three to five weeks it is usually found that the fracture has united sufficiently to permit the use of a sling.

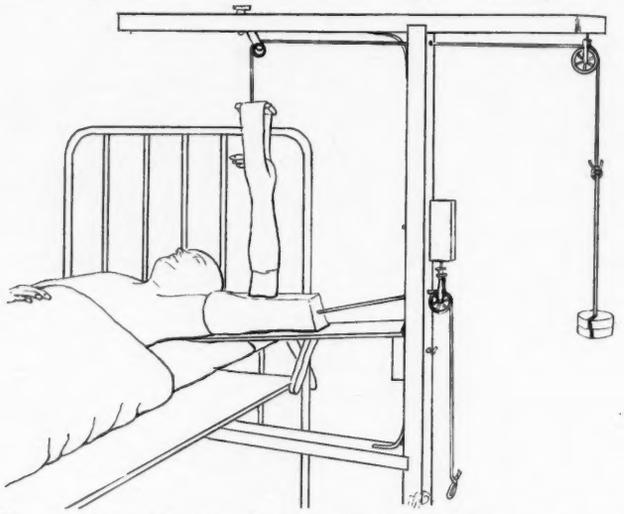

FIG. 5. Line drawing showing simple traction apparatus which may be arranged at patient's bedside.

FRACTURES OF RIBS

The more exposed ribs, the fourth to the eighth, are most subject to fracture. Compound fractures are rather rare owing to the elasticity of the rib and the rather extensive muscular attachment. In fractures which are the result of direct violence the fragments are driven into the underlying pleura or lung and thus more serious complications occur. As a rule there is very little displacement of the fracture ends since the intercostal musculature acts as a splinting agent. Fractures of the ribs are very rare in children owing to the elasticity of the bone. In adults and especially in the

aged these fractures may be the result of the most trivial accident or even muscular strain, such as is occasioned in coughing.

A B

Fig. 6. A, adhesive dressing completely encircles the chest. The vertical strap is added in fracture of the upper ribs. B, posterior view.

There is usually the history of thoracic trauma and the patient complains of pain in the chest which is aggravated by deep inspiration or coughing. There is point tenderness over the fracture site, occasionally crepitus may be felt or heard and anterior-posterior compression of the chest on the injured side will cause sharp pain at the fracture point. Very frequently, routine anteroposterior radiographs fail to show fracture and oblique views should be taken if necessary. If the clinical evidence of fracture of the rib is conclusive, treatment should not be withheld even though roentgenographic proof is lacking.

Treatment. Immobilization of the chest with adhesive strapping in most instances will give the patient relief from pain. Liberal doses of morphine or codeine in a cough mixture should be prescribed to abolish the cough reflex. The adhesive strips, each three inches in width, are applied from below upward with the chest held in full expiration and they are made to encircle the chest completely. In fractures of the upper ribs vertical strips extending over the shoulder of the injured side are added. (Fig. 6.) In obese females adhesive strapping may not be tolerated because of the pressure beneath the pendulous breasts. Some relief is afforded these individuals by encircling the chest with a wide elastic roller bandage (Ace), slipping being effectively prevented by stitching the edges of the bandage together in several places and adding stitched-on shoulder straps of muslin or webbing.

The adhesive dressing should be left in place for a period of three weeks and unlike strapping, which does not completely encircle the chest, will require no reinforcing.

FRACTURES OF THE SCAPULA

Occurrence. The incidence of fractured scapulae is probably less than 1 per cent of all fractures. Fractures of this bone are infrequent because of its free mobility and its heavy muscle padding.

Direct trauma is the usual cause in fractures of the exposed acromium and less frequently of the body and spine. Indirect violence is more frequently found to be the etiology, by transmission of force through the humerus, in fractures of the neck and glenoid. Indirect violence through the medium of muscle pull is the usual mechanism in fractures of the coracoid process.

Diagnosis. Most diagnoses of fractured scapulae are made by means of roentgenog-

raphy. The history of trauma, pain, occasionally swelling, tenderness and inability to abduct the arm are suggestive. Abduction is usually lost when this bone is fractured, since the scapula is immediately fixed by muscles of the shoulder girdle when movement of the arm is attempted.

In fractures of the body, pain and crepitus are occasionally elicited when the spine is grasped and the inferior angle manipulated. Fractures of the body are usually comminuted. The position of the fragments is generally good because of the heavy flat musculature covering the bone.

Fractures of the acromium may be diagnosed by direct palpation and comparison with the other shoulder, although usually there is not much displacement.

The diagnosis of coracoid fractures is difficult because of the deep position of this process, but pain upon abduction of the arm against resistance plus localized tenderness aid in the diagnosis.

Glenoidal fractures and fractures of the neck may or may not show displacement, depending on the amount of damage to the coracoclavicular and coraco-acromial ligaments. When displacement has occurred, the shoulder drops downward and inward and produces a deformity very similar to simple dislocation of the shoulder. However, in the former condition the head is not palpably displaced and the rotary motion at the shoulder joint is not lost. *X*-rays are of course indispensable.

Treatment. Immobilization of the arm and soft parts overlying the scapula is all that is needed in fractures of the body. A criss-cross strapping of adhesive is applied over the scapula during exhalation. The strips begin well down in front of the affected shoulder and end on the posterior chest wall of the opposite side. The axilla is padded with powdered sheet wadding, and the arm is strapped to the side with a wide band of adhesive which encircles the chest. The forearm is supported by a clove hitch around the neck or by a sling. The necessity for, and duration of immobilization depend entirely upon the comfort of the patient. Activity is gradually resumed after three to four weeks.

Fractures of the acromium and coracoid process require little in the way of fixation, inasmuch as the displacement is usually slight and fibrous union without disability is the rule. Immobilization may be accomplished by the simple method described for fracture of the body, and in older individuals a sling suffices. Active motion is started in either case at the end of three weeks.

For fracture of the glenoid and neck with displacement in young individuals, recumbency and lateral traction, as illustrated under fractured clavicle (Fig. 5), is the treatment of choice. Traction on the arm in abduction tightens the capsule and causes the fragments to be pulled into alignment. This form of the traction is used during the period of swelling and alignment of the fragments and at the end of ten days to two weeks may be replaced by an abduction plaster. Active motion is instituted in six to eight weeks and is supplemented by physiotherapy and light massage. Elderly patients with fractures of the neck or glenoid require the most conservative treatment. Crippling peri-articular adhesions frequently follow immobilization in this age group. In these elderly individuals the disability occasioned by some displacement of the fragments is minimal as compared with the loss of function occasioned by lengthy immobilization. In these cases we advise the use of a well fitted triangular sling and the institution of active motion at the end of two weeks. This sling routine suffices in younger patients who have no displacement.

FRACTURES OF THE BONES OF THE HAND*

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FRACTURES of the metacarpals and phalanges are the most common fractures of the human skeleton. Their presence often constitutes the only injury to the patient. For this reason they are likely to excite no grave apprehension. They are frequently regarded as minor injuries and their care entrusted to those who have given no special attention to this field. In fractures of the longer and larger bones of the skeleton an immediate appreciation of the gravity of the injury leads to better care and more diligent appreciation of the principles underlying proper management.

In 1932 we presented a paper[1] in which we outlined the mechanism of the production of the deformities and the principles underlying the reduction and fixation of fractures of the bones of the hand. Since then a constant check of the results in these fractures has impressively convinced us of the rich functional rewards which may be expected to follow studied application of the principles outlined at that time. The importance of the principles of management of fractures of the bones of the hand has been stressed recently in well written and clearly illustrated papers by Owen[2] and also by Rider.[3] In the present paper it is our purpose to emphasize certain practical applications of the principles of management to clarify points which have caused some confusion.

In general it may be said that the deformity following fracture of any bone may result from the direction of the force which produced the fracture; or the resultant action of opposing muscle groups attached to the fractured bone; or a combination of these factors. While the direction of the force which produced the fracture may influence to a considerable extent the position of the fragments of the injured bone, it is remarkable that in many instances fractures sustained at the same level usually result in a similar deformity directly related to the action of the intrinsic muscles whose tendons insert on the bones of the hand.

An appreciation of the functional anatomy of the intrinsic muscles and tendon insertions in the hand will assist greatly in an understanding of the principles employed in the treatment of these fractures.

Movements of the Fingers. Two separate series of movements occur in relation to the articulations of the fingers: flexion and extension (at the metacarpophalangeal and interphalangeal joints), and abduction and adduction (at the metacarpophalangeal joints only). The movements and the muscles concerned are given in Table 1.

TABLE 1

Flexion	Extension
Flexor digitorum sublimis	Extensor digitorum communis
Flexor digitorum profundus	Extensor indicis proprius
Lumbricales (acting on the metacarpophalangeal articulations)	Extensor digiti quinti proprius
Flexor digiti quinti brevis	Lumbricales (acting on the interphalangeal articulations)
Abduction	**Adduction**
Flexor brevis and opponens digiti quinti (from the medial side of the hand)	Volar interossei (to the midline of the middle finger)
Dorsal interossei (from the midline of the middle finger)	

The flexor digitorum profundus acts on the terminal phalanges. The flexor digi-

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torum sublimis and the flexor digitorum profundus together flex the proximal interphalangeal joint. Flexion of the metacarpophalangeal joint is effected by these muscles assisted by the interossei, lumbricales and flexor digiti quinti brevis. Extension of the phalanges is brought about by the united action of the extensors of the digits, the interossei and the lumbricales. Extension of the fingers at the metacarpophalangeal joints is produced solely by the long extensor muscles. Separate extension of the index finger only is possible; the three inner fingers can extend completely only together because of the connecting bands joining the extensor tendons on the back of the hand.

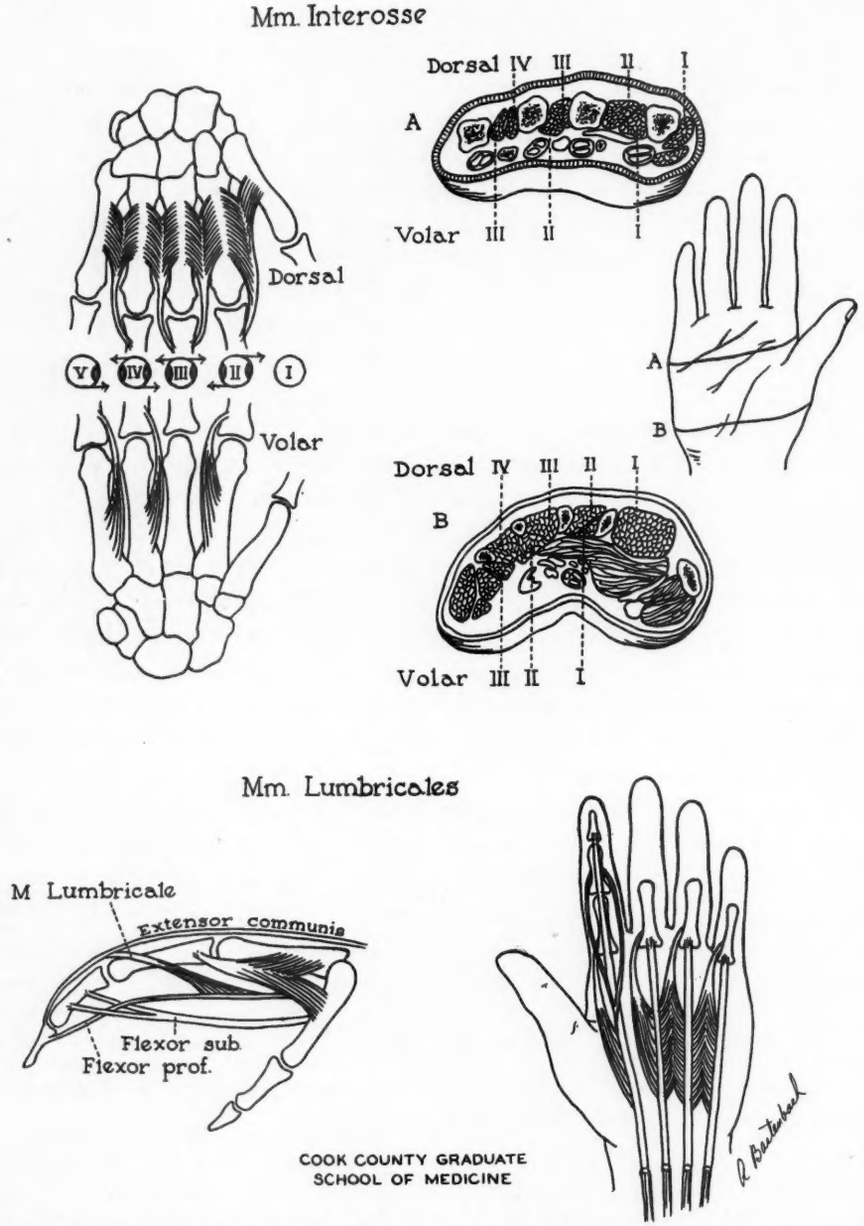


Fig. 1. The interossei and lumbricales. Origins, insertions and actions; diagrammatic.

The arrangement of the interossei and lumbrical muscles and the insertions of the flexor and extensor tendons are illustrated in Figure 1.

Fractures of the Distal Phalanx. The terminal phalanx articulates with the middle phalanx. When fracture occurs the

distal portion is free and not subject to the action of either the intrinsic or extrinsic muscles. It is here that considerable crushing may occur with but slight displacement. (Fig. 2A.) The comminuted fracture is often associated with a hematoma beneath the nail. In many instances it is necessary to relieve the pressure on the distal phalanx by evacuation of the hematoma through a drill hole in the nail. Failure to do so may result in necrosis of the distal fragments due to occlusion of the supplying vessels as they pass through the anterior closed space of the terminal phalanx. Fractures through the midportion of the distal phalanx are commonly associated with loosening of the nail due to elevation by a hematoma. It is inadvisable to remove the nail since it acts to some extent as a suitable splint.

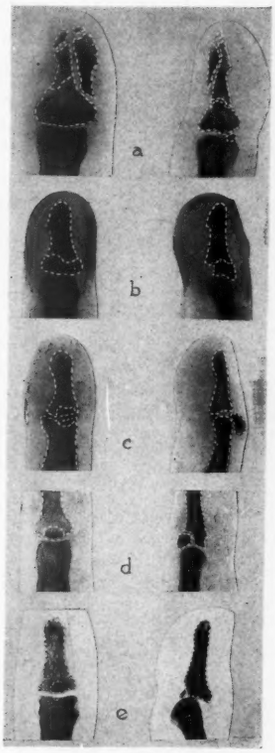
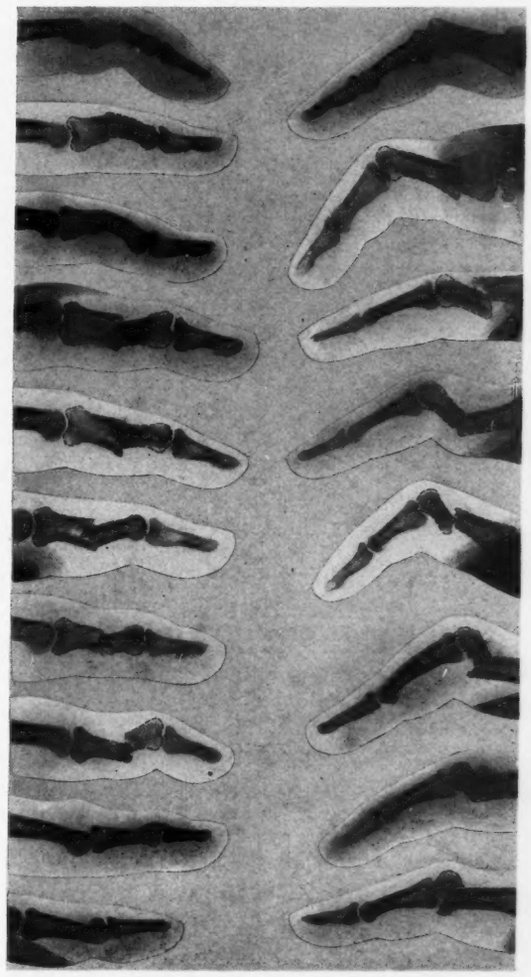


Fig. 2. Fractures involving the distal phalanx. The distal portion may show much fragmentation with little displacement. The proximal portion is influenced by the pull of the extensor or flexor muscles.

Moulding of the fragments into line with simple immobilization, including the distal joint for a period of two weeks is usually ample for relief from symptoms. While *x*-ray examinations show that healing is complete in approximately five months,[4] a much shorter period of fixation suffices.



A B

Fig. 3. A, fractures of the middle phalanx. Fractures in the proximal portion show the inverted v deformity. Fractures in the distal portion show the v-shaped deformity. B, fractures in the proximal phalanx. At all levels there is the v-shaped deformity.

Fractures involving the proximal portion of the terminal phalanx are subject to the action of the flexor digitorum profundus and the extensor digitorum communis. A fracture here may develop a varying degree of dorsal displacement of the proximal fragment. (Fig. 2B.) Occasionally, the entire proximal fragment may

be evulsed. (Fig. 2C.) In tendon avulsions the flexor or extensor tendon may take with it its bony insertion (Fig. 2D and E).

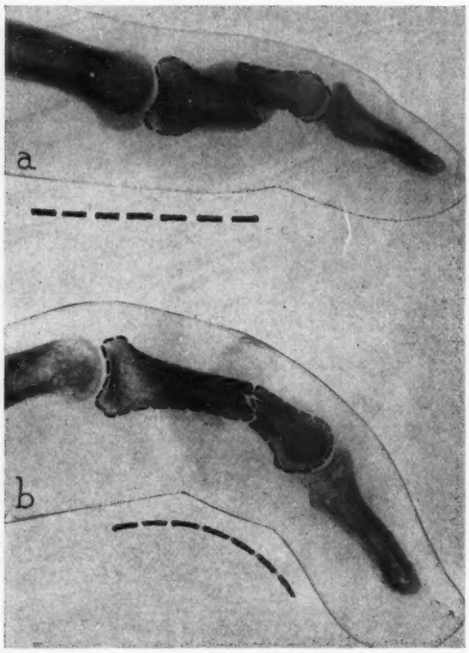


FIG. 4. The volar projecting spur as a result of fixation on a straight splint.

Fractures of the proximal portion require such immobilization as will approximate the fragments. The fracture illustrated in Figure 2C requires open reduction, 2D requires hyperextension and 2E requires hyperflexion. When hyperextension is required for treatment of the "dropped finger" or "baseball finger," immobilization in the correct position for a period of approximately six weeks is necessary. The Lewin splint is satisfactory for this purpose.

Fractures of the Middle Phalanx. Fractures of the middle phalanx often show no deformity and require simple immobilization. In many instances, however, a deformity related to the action of the flexor digitorum sublimis is present. This muscle ends in a tendon which divides into two portions. They insert on the volar surface of the middle phalanx, at approximately the midportion. The deformity usually noted following fracture of the middle phalanx depends on the location of the fracture site. If this site is distal to the insertion of the tendon, there occurs flexion of the proximal fragment and dorsal displacement of the distal fragment. When the fracture site is proximal to the tendon insertion, there results flexion of the distal fragment with the proximal fragment in an extended position. The accompanying illustration showing different sites of fractures of the middle phalanx demonstrates this. (Fig. 3A.) Failure to take into account these two types of displacement of fragments will result in a failure to correct this deformity. When a straight splint is used for fixation of a fracture distal to the insertion of the tendon there results most commonly a palmar projecting spur, which interferes with flexion of the distal phalanx. (Fig. 4A.) Adequate fixation can be had by bringing the distal fragment into line by a curved splint, restoring the fragments to a natural arc with proper alignment of the fragments. (Fig. 4B.) Fractures into joints and oblique fractures with overriding require longitudinal traction in addition to fixation for a more favorable result. Immobilization for a period of three weeks is usually necessary in the treatment of fractures of the middle phalanx.

Fractures of the Proximal Phalanx. The resulting deformity when fracture of the proximal phalanx occurs is fairly constant regardless of the site of fracture. (Fig. 3B.) Flexion of the proximal fragment is brought about by the action of the interosseus and lumbrical muscles while dorsal displacement of the distal fragment is due to the action of the lumbrical muscle alone.[5] Here again fixation on a straight splint will maintain the deformity and result in impaired function. When the distal fragment is brought into line with the proximal fragment by fixation on a curved splint, a minimum of deformity will result. Immobilization for three weeks is usually necessary for sufficient union to permit active and passive motion.

Fractures of the Metacarpal Bones (Exclusive of the Thumb). Fractures of the metacarpal bones usually result in typical deformities characterized by shortening

of the length of the bone due to bowing of the fragments. There is a dorsal projection at the site of fracture and volar displacement of the metacarpal head. (Fig. 5.) This deformity is the result of the action of the interosseus muscle which is a flexor of the proximal phalanx. The distal fragment of the metacarpophalangeal joint to the proximal phalanx and is drawn into a flexed position. This accounts for depression of the knuckle. "Recession" of the knuckle is due to the prominence of the distal portion of the proximal fragment.

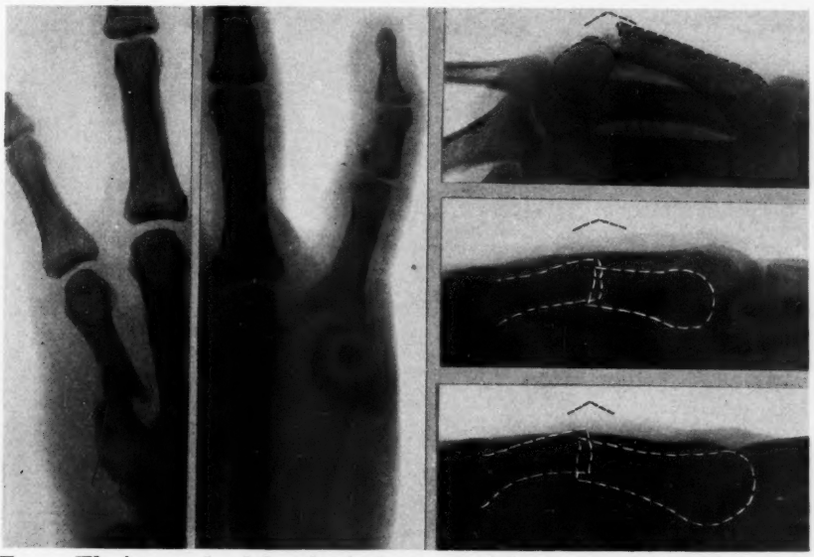


Fig. 5. The inverted v deformity in fractures of the metacarpal bones. Lateral displacement in the second and fifth metacarpal bones.

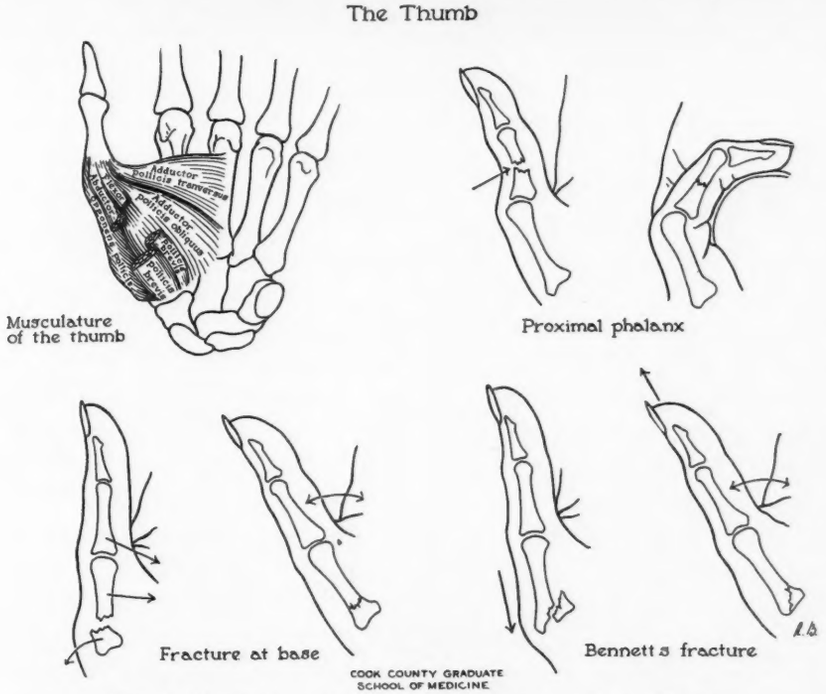


Fig. 6. Mechanism of deformity in fractures of the thumb.

The treatment of these fractures requires immobilization for a period of three weeks on a straight dorsal splint. This restores the normal horizontal contour of the

FIG. 7. Types of fractures of the thumb.

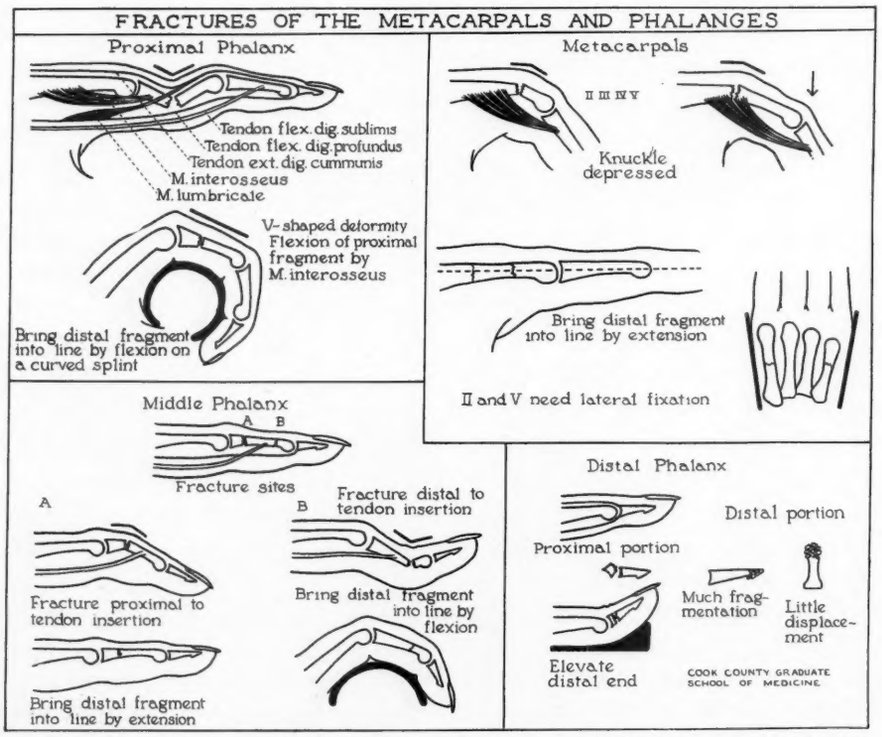


FIG. 8. The basis for mechanical fixation in fractures of the bones in the hand.

dorsum of the hand. Fractures of the third and fourth metacarpal bones are splinted laterally by their adjacent metacarpals. The second and fifth, when fractured, require lateral splinting in addition to dorsal splinting.

FRACTURES OF THE THUMB

Fractures of the Distal Phalanx. The treatment of fractures of this bone conform to the same principles as outlined for the other distal phalanges.

Fractures of the Proximal Phalanx. When fracture of the proximal phalanx of the thumb occurs there usually results a v-shaped deformity. The proximal portion is adducted and flexed due to the action of the adductor muscles of the thumb and the flexor pollicis brevis. (Fig. 6A.) Fixation on a curved splint or roller bandage will overcome the deformity.

Fractures of the First Metacarpal. In 1933 we presented a classification of fractures of the first metacarpal bone with a discussion of the anatomy and mechanism involved in the various types of fractures.[6] (Fig. 7.) The usual deformity is adduction of the distal fragments with abduction or extension of the proximal fragment. Treatment by marked abduction so as to preserve the web of the thumb and avoid contracture of adductor muscles is essential. (Fig. 6B.)

In the Bennett type of fracture, if marked abduction fails to restore the alignment and overcome the dislocation of the shaft, traction in addition to abduction is necessary (Fig. 6C.) Immobilization for three weeks with subsequent careful use is necessary for healing.

The materials used in the maintenance of these corrected positions are those commonly used in other fractures: tongue depressors, strips of aluminum, adhesive tape, roller bandages of various sizes and Plaster of Paris.

In a study of fractured bones, Zuppinger made use of fundamental geometrical principles in explaining and designing the use of various mechanical applications of force to produce correction of the deformity. Practical application of Zuppinger's studies is exemplified in the ingenious method of application of a malleable volar splint applied to the finger in extension and firmly secured by adhesive material. The splint is bent in a curved manner carrying the finger in an arc of palmar flexion. This maneuver increases the length of the dorsal arc, thereby producing traction as well as affording a natural curved support for the fractured member. In such applications as this, one should be careful to preserve the blood supply to the part. The necessity of frequent examinations and avoidance of undue pressure or constriction cannot be overemphasized.

Compound fractures of the metacarpals and phalanges are met with very frequently. One must decide at once in these injuries the character and extent of the damage and plan the treatment to the end that the patient will have the best functioning hand which can be salvaged. Where the soft parts are greatly damaged the operative manipulation of fractures may serve further to contaminate the wounds or impair the vitality of the tissues. In these cases one may be compelled to restrict his activities to a thorough debridement coupled with the simplest of corrective splinting and dressing. As improvement occurs one should constantly attempt to restore the member and its injured parts to a position which will insure ultimate usefulness. Skeletal traction while of advantage in the alignment of the fractured bone may serve to decrease the blood supply to the injured soft parts. It is better to postpone active traction until the vitality of the soft parts is assured. The necessity of cleansing the wound with the avoidance of strong chemical antiseptics cannot be overemphasized.

SUMMARY

A summary of the metacarpal and phalangeal deformities with general principles of management is illustrated in Figure 8. It is evident from these illustrations that

the principle of aligning the mobile distal fragment with the less mobile proximal fragment is applicable to all fractures of the bones of the hand.[7] This rule simplifies the essentials of treatment and relieves one of remembering the mechanisms involved in the various displacements.

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The application of some form of splint is the first procedure in the treatment of every fractured limb. . . . The need of immediate immobilization of compound fractures is most urgent.
From—"Fractures and Dislocations for Practitioners" by Edwin O. Geckeler (The Williams & Wilkins Company).

A FINGER SPLINT THAT WILL NOT IMPAIR HAND FUNCTION*

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NOT long ago, due to a severance of the extensor tendon of my index finger, I found myself in need of something that would maintain extension of my finger yet permit good usage of the rest of the hand. This explains my interest in finger splints.

During the first five to seven days after injury, one is perfectly willing to be quiet, not using the hand, because of pain. After this, there is no good reason why one should not be able to use the other fingers of the hand, but the usual gauze bandage and splints practically prohibit effective usefulness. Within a few days, several factors of greater or lesser importance presented themselves as objectionable features in the customary methods of splinting fingers. These can be mainly grouped under (1) personal discomfort, (2) disability due to the mechanical appliances, (3) physiologic disturbances due to bandaging and immobilization of the finger.

It is natural to expect some pain from a wound deep enough to cut a tendon, but one's general comfort can be considerably promoted by eliminating a few disagreeable details connected with a cumbersome splint. It was particularly noted that the extension of the splint beyond the finger made it necessary to guard every movement of the hand, otherwise the splint would strike against something and cause pain in the finger. Bulkiness of the splint, gauze and bandages between the fingers abducted the adjacent fingers enough to be uncomfortable. Also, the gauze in apposition to the wound adhered to the suture line and caused a burning pain when an attempt was made to use the hand. This pain is due to a slight slipping or movement of the splint, producing a tug on the raw surface of the wound by the adherent gauze. Soiling of the gauze bandage required frequent changing, and this is not only uncomfortable but undesirable.

Aside from the pain and discomfort as mentioned above, extension of the splint down the palm of the hand impaired the usage of the entire extremity. Scrubbing is entirely out of the question for weeks, because of the splints used to maintain extension. It is impossible to use gloves over a bandage. Because one cannot scrub or use gloves any possibility of doing any sort of surgical procedure is precluded. In other words, the splint keeps one from working.

The circular bandage wrapped about to maintain the splint, or the plaster splint applied to the finger impairs the circulation of the finger, particularly its tip. This undoubtedly retards healing. Unless the splint or cast is applied quite snugly there is some difficulty in maintaining extension.

Some of the above may seem to be trivial complaints, but nevertheless, all added together over a period of time, present a reminder that there should be a better way to splint a finger and enjoy the security of the splint without enduring so many inconveniences.

Collodion seemed to answer the purpose better than any other substance used as a splint. Because it is effective, comfortable to the patient, and materially diminishes the period of disability, I have deemed it worthwhile to call this method of splinting

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to the attention of men doing general surgery. It may have been used before, but certainly not so much as it should be.

Collodion serves the purpose of any other splint and adds many advantages. Some disadvantages are peculiar to collodion alone, but the advantages outweigh these.

FIG. 1. Anterior view, showing extent of application of collodion.

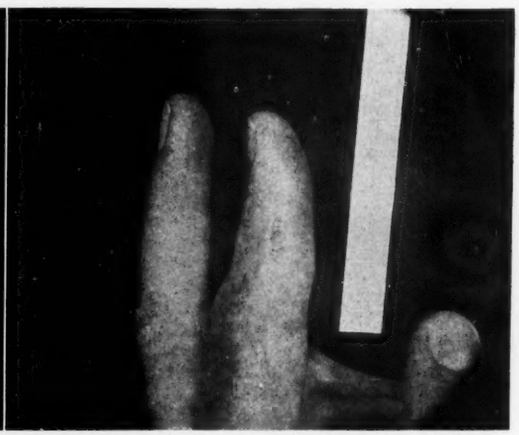

FIG. 2. Lateral view, showing hyperextension of finger and reduction of swelling at fingertip.

Ordinary collodion is used in preference to flexible collodion. It must not be too thin. It is applied with a cotton applicator from the middle of the lateral surface on one side to the middle of the lateral surface of the other side, then it is rapidly applied over the dorsal surface of the finger. In the distal phalanx, it is only necessary to extend the collodion from the tip of the nail to just above the second phalangeal joint. After one coat has been applied, a second is applied immediately and then a third may be added. It is a good idea to place the two index fingertips in apposition and exert a little pressure, so as to produce a slight hyperextension. When the collodion dries and contracts the extension will be increased; if too pronounced, this causes pain. A slight extension is sufficient, as contraction of the collodion will produce the proper amount of hyperextension.

Collodion may be applied directly over the wound without any gauze beneath it. The collodion is sterile and transparent; the condition of the wound can be watched through it. If serum should accumulate, which did not occur in my case, the collodion can easily be removed by peeling it off from one side to the other.

It was noticed that the swelling was entirely relieved a short time after the collodion splint was applied. The collodion contracts, causing a reduction in size of the member rather than a swelling. I am firmly convinced that the circulation is better with the collodion method of splinting.

Collodion seems to permit the skin to heal better under it. The epithelium proliferates and spreads rather than piling up along the edges of the wound. When gauze is applied to the finger and firm bandage added, there is a tendency for the wound margins and the skin about them to become red and tender. The margins of the wound do not approximate themselves as firmly and completely as they do with the collodion dressing.

The collodion can be peeled off readily without pain and can be re-applied in a moment with the utmost ease. One can use the hand naturally and know that the finger is splinted; one can bathe, and there is no large white bandage for everybody to notice and comment on. This last saves endless and tiresome explanations.

IMPROVED MANAGEMENT OF GANGRENE OF THE FOOT

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OUR interest in the subject of arteriosclerotic and diabetic lesions of the foot was aroused by the very poor results reported in the literature,[2] the average mortality reported following major amputations being about 30 per cent. At the University of Minnesota Hospital, over a five year period (1930–1935) the mortality following major amputations for arteriosclerotic and diabetic lesions was 24 per cent. The reported morbidity also is appalling, Taylor reporting that only 20 per cent of patients had primary healing of the stump. He also reported an average hospital stay of fifty days.

It has been calculated that, classifying infection as "avoidable," there should be about 5 per cent mortality in major amputations from unavoidable causes. Very few reported series even approach this figure.

After observing the methods of Dr. A. A. Zierold at the Minneapolis General Hospital, and using his method and technique for one year, we can report a definite improvement in results. The yearly mortality from 1930 through 1937 had varied from 27 per cent to 30 per cent, about fifteen major amputations being done each year. In the one-year series here reported, twice as many amputations were done without a single death. Our cases are not selected and a report is given of every patient seen from July, 1938 through June, 1939.

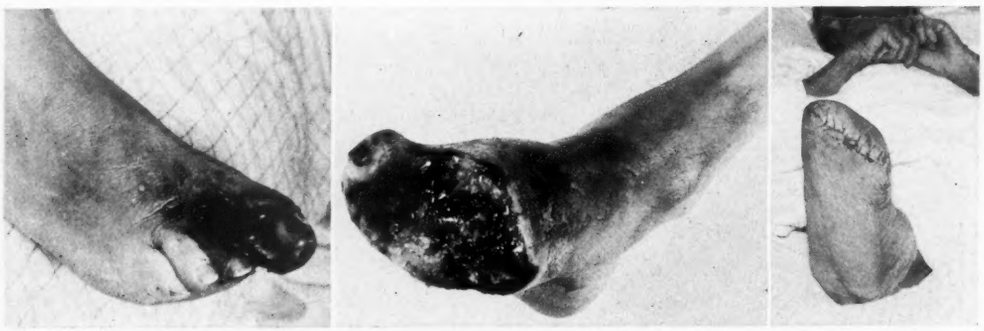
A common subterfuge in reporting an operative series is to treat conservatively all poor risk patients. We have not resorted to this. In previous years at Minnesota General Hospital, about 52 per cent of patients in the group under consideration were subjected to major amputation, while in our series, 70 per cent (twenty-eight patients) had major amputations. This figure is in agreement with those reported in other series, indicating that we have not been too radical in advising amputation.

Obviously, the poor results commonly seen are due to a generally accepted but faulty method of handling cases of diabetic or arteriosclerotic gangrene of the foot. Close preoperative coöperation between physician and surgeon has improved the results of therapy. John found that eleven surgeons who coöperated with the medical men had a collective mortality rate of 3 per cent, while one surgeon who refused to delay amputation until diabetes was controlled, had a mortality of 18 per cent. We should like to emphasize strongly that major amputation never should be an emergency procedure in diabetes and arteriosclerosis.

Pathology. Arteriosclerotic and diabetic lesions on the lower extremities may be present purely as a result of infection; they may be the result of vascular occlusive changes; or there may be a combination of these factors. One bilateral periungual infection of the great toes in a diabetic was seen in this series and was successfully treated by saline soaks. These lesions usually are not serious but may become so, in diabetics. Interdigital epidermophytosis is the most frequent precipitating cause of diabetic gangrene. One case of chronic osteomyelitis of the tarsus in a diabetic was successfully treated by repeated application of plaster casts.

Dry gangrene is dry because the primary lesion involves arterial occlusion with ischemia of the tissues which are effectually drained of tissue fluids by means of the veins and lymphatics. This type of

gangrene can no more become infected than can a mummy, although the granulation tissue at the line of demarcation can become infected. Moist gangrene occurs when venous or lymphatic return is impeded and the tissues become waterlogged either because of primary venous disease or more usually because of infection, gangrene being secondary to toxic vascular and tissue change. This concept does away with loose talk about dry gangrene becoming infected and puts cause and effect in their proper sequence. Arteriosclerotic patients most often develop dry gangrene because of progressive vascular damage, while diabetics usually have moist gangrene without premonitory vascular symptoms because of the well known predisposition to infection. This explains the variation in mortality in the two groups.



A B C

FIG. 1. White female, 65, entered hospital with infection and gangrene of first and second toes of right foot of three months' duration. The dorsalis pedis pulse was absent, temperature ranged to 102 daily and the pulse rate was about 120. During four days of conservative régime, four toes became involved and a plantar abscess developed. Debridement was done, excising four toes and the heads of the metatarsals. The highest temperature after debridement was 101 and pulse was 104. After five days of 40 per cent cod liver oil ointment dressings, low thigh amputation was done. Milk culture made from the amputation site was positive for gas-forming organisms but no serum was given. The highest temperature after amputation was 99.4 on the eighth day and pulse 118 on the third day. Total hospital stay was twenty-two days (thirteen days after amputation). A, original lesion. B, wound after debridement. C, healing stump six days after amputation. Patient left the hospital in good condition, but died within the next year of intestinal obstruction caused by a gallstone.

Theory of Debridement. It is our opinion that the high mortality in major amputations for arteriosclerotic and diabetic gangrene is partially due to the fact that the patient is incorrectly prepared for operation. A patient with an elevated pulse rate and a septic type of temperature curve is not a good candidate for any major operation. No major amputation was done in this series when the temperature of the patient was above 100 degrees. To lower the temperature and pulse rate in any case of gangrene of the foot where major amputation is necessary, the patient is taken to the operating room and under general anesthesia (pentothal intravenously or cyclopropane by inhalation) all necrotic tissue is removed by sharp dissection until a flat, bleeding wound is produced. This debridement may include one or more digits, metatarsals and all overhanging soft tissues. This wound then is covered with a heavy layer of 40 per cent cod liver oil ointment and a sterile dressing is applied. There being now no source of toxic absorption, the temperature and pulse rate drop promptly and dramatically to near normal by the next day. Herein lies the benefit of the procedure, but also a source of great danger. The surgeon, in the presence of a normal temperature and pulse and with a clean-appearing wound, is tempted to procrastinate and see if the lesion will not spontaneously heal. Within three to five days, however, the bacteria already in the wound, begin to make their presence known by septic temperature again, the wound develops an unhealthy

gray color and the favorable time for amputation has been lost. Debridement can be compared to scraping off the bacterial colonies from the surface of a dish of culture medium. It then takes a few days before a heavy bacterial growth appears again. In the early phases of our experience, when we did not appreciate that debridement is a preliminary to major amputation and not a final form of treatment, we have seen patients who had two or three debridements only to die of septicemia without amputation. Our procedure is to debride the wound thoroughly, and, after the patient's temperature has been down for about two days, perform a major amputation. This debridement should not be confused with local amputation which has entirely different indications and is a final procedure in itself in a limited number of cases. Debridement is indicated only in cases of septic temperature, where the lesion is on the distal part of the extremity and where major amputation is required.

Operative Technique. When the diabetes has been regulated and the patient's general condition is brought to as near normal as possible, by debridement if indicated, the patient is ready for operation. Cyclopropane was used routinely as an anesthetic in our series. The time element in any operation is very important, but time must not become a fetish with the surgeon. Our procedure we call the anatomic method, each structure being recognized as it is exposed and every vessel grasped with a hemostat before it is cut. In this way the operation progresses in an orderly fashion, there is no blood loss and the patient does not develop shock. A 30 per cent mortality in patients operated upon in ten minutes is not commendable; a mortality reduced to zero in patients whose amputations required thirty minutes each, is a good result.

The low thigh amputation usually has been used in this series, the skin being incised just above the prepatellar bursa and the femur about 6 cm. above the condyles. A tourniquet never should be used in major amputations for arteriosclerotic or diabetic lesions because of the obvious danger of a nonhealing stump.

Fig. 2. Diabetic white female, 65, entered hospital because of draining sinuses in all interdigital spaces of left foot, developing on the basis of fungus infection. Necrotic tissue extruded through the sinuses and at debridement a plantar abscess was found with destruction of the soft tissues of the three middle toes. Six days after debridement, the temperature went to 101.4 and the pulse to 104. Low thigh amputation was done and the highest postoperative temperature was 100.4 and pulse 120. Stump healing was satisfactory and the patient was dismissed twelve days after amputation.

No retractors should be used on the stump and the tissues should not be severed at different levels because the blood supply goes superficially almost at right angles so that a tapered stump increases the likelihood of slough. Skin flaps are not fashioned in the usual sense of the word except that a double curved incision is made to avoid the "dog ears" at each corner. These curved skin flaps are not undercut at all. The stump is closed tightly by means of interrupted sutures of silk and no drain is employed. The drain serves no good purpose and may do harm because it necessitates a change of dressing before the optimum time.

We feel that a suitable dressing is very important and should not be left to the assistants to apply. A vaseline strip is placed over the line of incision and the

stump then is covered by a smooth, snug dressing maintained by a 5 yard gauze roll applied after the manner of a melon head dressing. The stump is supported on a pillow and the dressing is not changed until the eighth postoperative day unless some complication arises. Early change of dressings before sutures are to be removed is meddlesome and unnecessary.

Fig. 3. Diabetic white female, 63, entered the hospital with infection and gangrene of the left great toe of two months' duration. During nine days of conservative régime the temperature went to 103.6 and pulse to 104. The result of debridement is shown. Thigh amputation then was done with a postoperative reaction limited to 100.4 temperature and 108 pulse. The patient was in the hospital sixteen days after amputation. Follow-up showed satisfactory recovery.

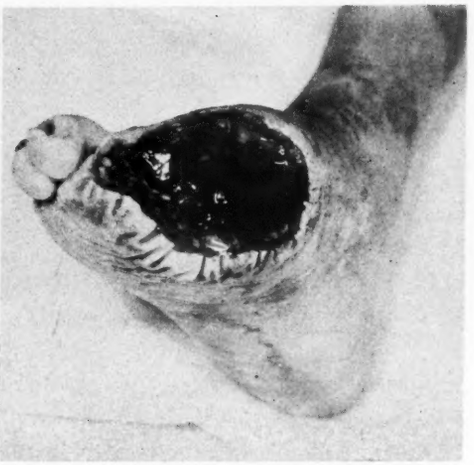


Fig. 4. White male, 69, had recurring gangrene of the great toe over a ten-year period following trauma. Amputation of the toe was done elsewhere and was followed by a nonhealing lesion which we saw after three months. Debridement was done and the temperature remained normal for five days. A lower leg amputation then was done with prompt healing of the stump permitting dismissal ten days after amputation. Follow-up was satisfactory.

Complications. Septicemia, the dreaded complication of diabetic gangrene was seen in our series in three cases. One patient died during the night of admission without treatment other than efforts at regulation of the diabetes. A second patient developed septicemia while being treated conservatively because he refused amputation and the third was the patient previously mentioned who developed septicemia following multiple debridements. Infection of the stump is frequent in most reported series but was not seen in any of our patients. Photographic records of every case bear out this statement. Slough of the stump occurred in a minor degree in one case and a small hematoma was evacuated in one instance. All other cases showed primary healing of the stump.

Milk cultures for gas bacilli were made both distally and proximally of both muscle and skin at the time of operation in every case and in no case did gas gangrene develop. Thirty-eight per cent of these cultures showed gas formation, but the patient's clinical course was uneventful and serum was not given except in one case where one ampule was given without our order. The finding of Manson that 35 per cent of indolent leg ulcers harbor *Cl. welchii* has been unduly emphasized in some clinics. This fear of gas gangrene has led to the practice of Roentgen examination of the stump for evidence of gas in the tissues. It does not seem to be generally known that every stump will show bubbles of air, included at the time of closure of the stump. Demonstration of this included air is about as sensible as taking a flat plate of the abdomen after every laparotomy to see the air under the diaphragm. In the presence of normal temperature and

pulse, a positive milk culture may be disregarded, in our experience. In one case in this series, a leg amputation, previously done, had been followed by gas gangrene. We performed a thigh amputation in this case before the original wound was completely granulated and healing was by primary union.

Hospital Mortality. In the arteriosclerotic group, there were nine major amputations with no deaths and in the diabetic group there were twelve major amputations with no deaths. The only patient who died following a surgical procedure was a man who refused amputation and had drainage of an abscess after septicemia already had spontaneously developed. The patient who died following multiple debridements has been mentioned. The operative mortality for major amputations is zero and the total mortality for the year's series, including the septicemias and conservatively treated cases is 12 per cent.

Hospital Days. In the arteriosclerotic series, the average hospital stay was sixteen days and the average postoperative stay was eleven days. In the diabetics, the average hospital stay for those treated conservatively was twenty-one days and for those treated conservatively followed by amputation, twenty-five days. The average postoperative stay was thirteen days. The patients were dismissed with healed stumps which did not require dressings.

Late Results. In the arteriosclerotic group, although the average age was 71 years, there were no known late deaths. The late results in the diabetic group, however, were not so good. One man had a toe amputation and after leaving the hospital against advice, subsequently died in diabetic coma on the medical service. Of the diabetics who had major amputation, 22 per cent died in the next year of cardiac failure, diabetic coma and obturation intestinal obstruction by a gallstone.

SUMMARY

A method has been outlined whereby the mortality following major amputation in arteriosclerotic and diabetic gangrene of the foot has been materially lowered. Postoperative complications have been largely avoided and the hospital stay has been greatly shortened.

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SUPERNUMERARY METATARSAL BONE AND TOE

CASE REPORT

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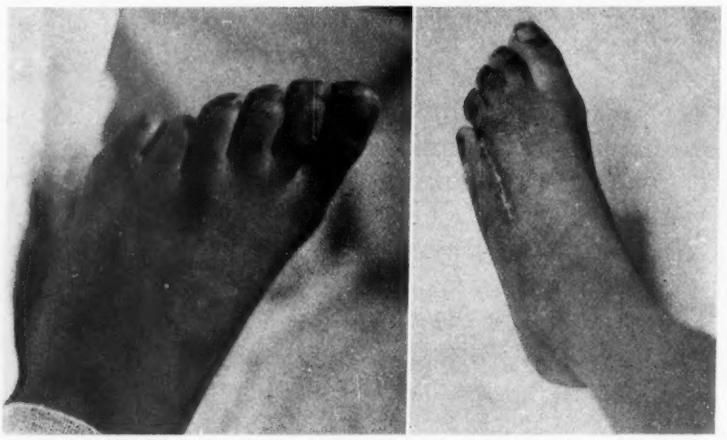
A COLORED female, age 16, had had a deformity of the left foot since birth. It had caused her considerable embarrassment and had created a constant problem in the fitting of her feet with comfortable shoes. The left foot was considerably broader than the normal right foot and presented six normally developed and functioning toes. (Fig. 1A.) A roentgenogram revealed that six metatarsal bones were present. The sixth metatarsal bone was in valgus position and was foreshortened, its shaft bowing outwards, and its broad base articulated with the cuboid bone and with the base of the fourth metatarsal bone. The fifth metatarsal was broad and short and was fused at its base to the shaft of the fourth metatarsal bone and distally to the head of the sixth metatarsal bone. The fourth metatarsal was in slight varus position and presented some maldevelopment of its head. All the toes had three phalanges except the sixth which had two. The medial three metatarsals and the tarsal bones were normally developed. (Fig. 2A.) A roentgenographic study of the right foot revealed a normal bony architecture.

The following operative procedure was devised to correct this deformity and was based upon a procedure employed previously in the correction of an unusual hallux varus deformity.[1]

A diamond-shaped portion of skin was excised from between the fourth and sixth toes, its base at the web. The apex on the plantar surface extended 1½ inches proximal to the web, and the apex on the dorsal surface extended 3½ inches proximal to the web, parallel to and between the shafts of the fourth and sixth metatarsal bones. The fifth metatarsal was exposed, detached from its bony attachments to the fourth and sixth metatarsal bones by means of an osteotome, and removed with the fifth toe. The bared surfaces of the fourth and sixth metatarsals were smoothed with a file and covered with adjacent soft tissues. The valgus deformity of the sixth metatarsal bone was corrected by the removal of a sufficient wedge of bone at its proximal end, the base of the wedge being directed medialward, and the cartilage of the adjacent base of the fourth metatarsal and the cuboid bones were removed in order to secure fusion between these three bones. The shafts of the fourth and sixth metatarsals were held approximated by a free loop of tendon (previously excised extensor digitorum longus tendon to the fifth toe), the ends of which were sutured to each other and to the



A B

FIG. 1. Left foot. A, before operation. B, after operation.

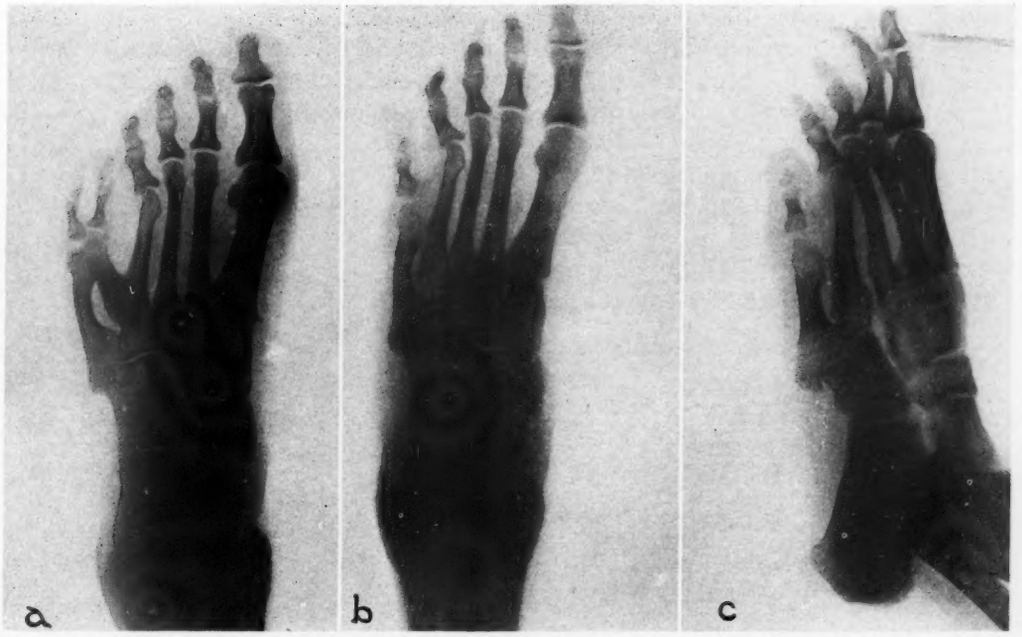


FIG. 2. a, dorsiplantar view before operation. b, after operation. c, oblique view after operation.

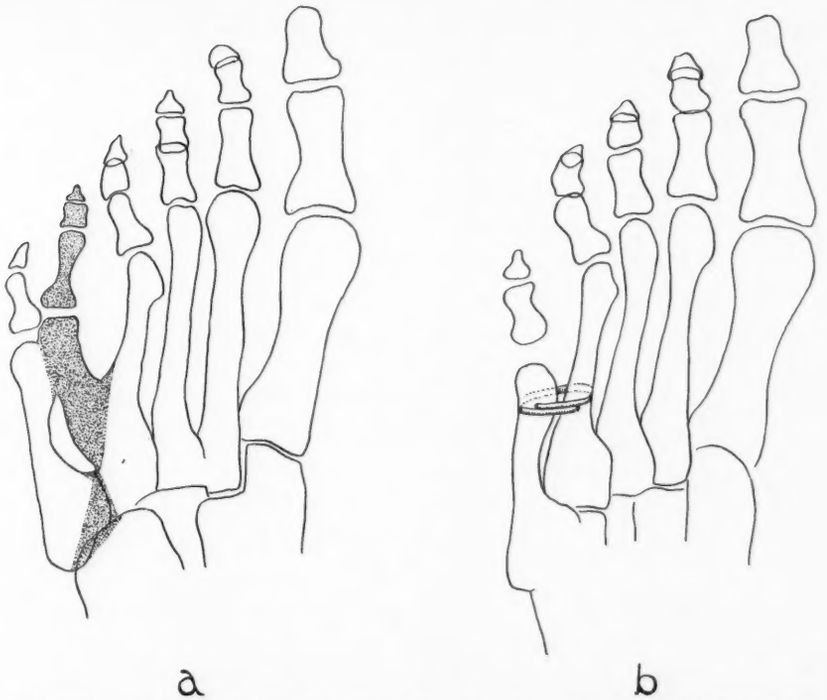


FIG. 3. Operative procedure. a, shaded areas represent bone excised. The fifth metatarsal bone and fifth toe were excised; the valgus deformity of the sixth metatarsal bone was corrected by the removal of a wedge of bone, proximally, with its base directed medialward; the articulations between the bases of the fourth and sixth metatarsal and the cuboid bones were denuded of cartilage to secure bony fusion. b, the shafts of the fourth and sixth metatarsals were approximated by a free loop of tendon (extensor digitorum longus to the fifth toe).

surrounding tissues under adequate tension. (Fig. 3.) The deep tissues were approximated with interrupted chromic catgut sutures and the skin with a continuous dermal suture. Fixation was maintained for six weeks by means of a plaster of Paris bandage and non-weight bearing was continued for an additional two weeks. The wound healed per primam.

By this method the more normally developed sixth metatarsal bone and its corresponding toe were preserved; the scars were placed on the dorsal and plantar surfaces of the foot, away from any pressure points; and an excellent cosmetic and functional result was obtained. (Figs. 1B, 2B and C.)

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Fractures of the metatarsal bones which are in good position unite in four weeks, although painful excess callus may result from early weight-bearing.
From—"Fractures and Dislocations for Practitioners" by Edwin O. Geckeler (The Williams & Wilkins Company).

TREATMENT OF A SPRAINED ANKLE*

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A SPRAIN of an ankle is looked upon by the majority of laymen as a semiserious condition, by some as a mild affair and inconvenience, but by others as a major injury. The latter group is made up of those who know either a relative or a friend who sprained his ankle "years ago and even now the ankle will turn if he does not watch his step."

The usual procedure in treating a sprained ankle is to put on some type of adhesive strapping, give the patient a pair of crutches and warn him against weight bearing. This is continued for about two weeks. Then physical therapy is started to reduce the swelling and relieve the pain on weight bearing. Such treatment is continued for about two weeks, during which time the patient gradually begins weight bearing and as he does so the swelling and pain progressively disappear.

This method does in time relieve the condition, but in the meantime it has cost the patient considerable pain, discomfort and inconvenience as well as a medical fee. In addition, if the patient happens to be a wage earner in other than the white-collar class, there has been a decrease in his income.

To eliminate the majority of the objections to the above method of treatment, our clinic over the past three and one-half years has worked out a routine treatment which with us has been very successful. This treatment not only relieves the discomfort and pain, but materially shortens the course of treatment and the period of disability. It also practically eliminates that late phase characterized by the slow disappearance of edema, which is so distressing to both doctor and patient, particularly in women.

TREATMENT

Our treatment of a sprained ankle is as follows: After a careful examination shows that there is no complete tear of a ligament and roentgenograms reveal no fracture or dislocation, the patient's leg is elevated to an angle of 45 degrees to reduce the swelling due to dependency. Of course, if the patient is seen a relatively short time after the accident, this type of swelling will be of no great moment. Next, those areas painful to pressure are injected with not less than 10 and never more than 20 cc. of a 2 per cent solution of procaine hydrochloride. We like to use about an 18 or 20 gauge needle, as the injection into the ligamentous tissues is easier than when using a needle of smaller bore. In five minutes the majority of the swelling caused by the injury can be massaged away.

We now make ready our adhesive tape strips. One and one-half inch tape is used. We do not favor the waterproof type of adhesive, as the back of this is rather stiff and it does not mold well around an ankle. The strapping is carried in stirrup fashion around the foot and extends up the leg to above the middle of the lower leg. Four strips of the necessary length are torn and arranged on the edge of a table that is within easy reach. Next, two strips, each three-fourths the length of the preceding four, are torn and arranged to follow the full length ones; and then two strips, each one-half the length of the full length strips, are torn and arranged to follow the three-quarter lengths.

The leg is shaved to above the height to which the strapping is to be carried. The shaved skin is painted with tincture of merthiolate, and when that dries, with

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mastisol. The majority of skin irritations that occur under adhesive tape will be prevented by the use of these two solutions.

Fig. 1. Photograph showing patient on side of table, holding foot at right angle with bandage, and also adhesive strips hanging from table edge. First 4 strips have been applied.

The patient sits on the side of the examining table with the sound leg resting on a stool. He holds the injured foot by means of a piece of gauze bandage passed under the ball of the foot, the ends being held by the corresponding hands. He can thus keep the foot at a right angle and by pulling harder with one hand than with the other he can invert or evert the foot, depending on which ligament has been strained. The heel of the foot is rested on the surgeon's knee for steadiness while the strapping is being done. (Fig. 1.)

The ankle is strapped with the foot at a right angle for men and in a little equinus for women. The latter wear shoes with higher heels, and if the foot is strapped at a right angle, walking becomes difficult. Immediate weight bearing is the necessary and important second phase of the treatment. Also, because of weight bearing, we never strap an ankle in inversion or extreme eversion, but rather in a neutral position for those infrequent strains of the ligaments on the medial side, and in slight eversion for those on the lateral side.

Strapping. Two full length strips of tape are applied stirrup fashion, starting the first far back under the heel and drawing it quite tight on the side of the sprain. (Nos. 1 and 2 in Fig. 1.) The second overlaps the first about one-half the width. The third full length strip is started similarly, but the ends cross on the front of the lower leg. (No. 3 in Fig. 1.) The fourth full length strip has a dual purpose. The first part is used as a binder and finisher for the ends of the previously applied strips, and the remainder is applied in stirrup fashion to reenforce the first two. (No. 4 in Fig. 1.) The first three-quarter length strip is applied unequally, so that the long end swings around the plantar surface of the arch, across the dorsum of the arch obliquely, and around the side of the ankle opposite to the strain, and is drawn quite tight. Any excess that would cover the tendo Achilles is cut off. The second three-quarter strip is applied in a similar manner, overlapping the previous one about one-half the width. (Nos. 5 and 6 in Fig. 2.) The piece of gauze with which the patient is holding the foot is removed. The first one-half length strip is applied overlapping the second three-quarter strip by one-half, and as the end on the outer side of the foot is brought around, the forefoot is pronated so that the foot will hit flat on weight bearing. (No. 7 in Fig. 3.) The forefoot is put in this position in every case regardless of the side on which the ankle is sprained. The second one-half length strip is used as a binder for the finished strapping in that portion just above the malleoli where, because of the contour of the ankle, the tape has a tendency to bridge. It is applied as a transverse band at this level but extends just beyond the edges of the first full length strip and does not completely encircle the leg. (No. 8 in Fig. 3.) The strapping is now covered with gauze bandage, which is worn for twenty-four hours, to allow for better setting of the adhesive tape.

When the strapping is completed, the patient is directed to put on his sock and shoe and begin immediate weight bearing, walking in as normal a manner as the strapping will permit. Crutches are hardly ever provided but a cane is supplied to the more timid. The majority of patients are agreeably surprised to find that they have no pain in the joint which twenty to thirty minutes previously was very painful on weight bearing. The patient is further instructed to continue weight bearing and not to favor the ankle. After about an hour, the effect of the procaine solution has worn off and there may be some return of discomfort, but if walking is persisted in this will gradually disappear in one to two hours.

In the more laborious occupations the patient may be unable to do his full work for seven to ten days, but other patients are usually able to continue work. It has been our experience that the strapping has to be renewed about every five days because it gets loose, due to slipping and to gradual reduction of the swelling, and thus does not afford the necessary support. It is rarely ever necessary to continue the strapping beyond three weeks, and the average time is about two weeks.

Fig. 2. Photograph showing strips No. 5 and No. 6 in place.

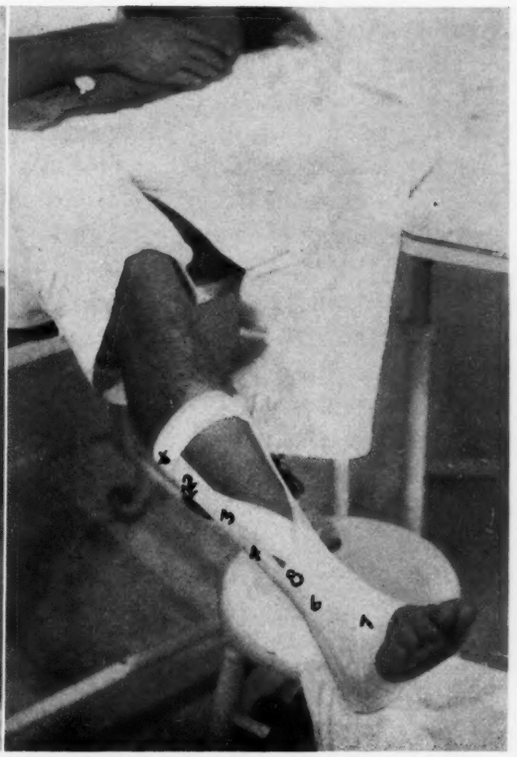

Fig. 3. Photograph showing finished strapping, but without final gauze bandage.

This method of strapping affords maximum support to prevent lateral motion and still allows considerable dorsiflexion and plantarflexion. There are no straps which encircle the leg above the middle of the longitudinal arch; the whole back of the leg is open from the heel to the knee, thus there is no interference with the circulation. In a few cases some swelling may occur after the strapping is applied. Relief can be secured by cutting the encircling bands on the dorsum of the foot, but support of the ankle is still maintained. In addition, there are no straps across the tendo Achilles to cut in, as in a Gibney or basket-weave.

While the method of strapping here described has in our hands given results superior to those secured by the use of any other, we feel that the major adjuncts

to it are the injection of the painful areas with procaine hydrochloride solution and the immediate and continuous weight bearing without the aid of cane or crutches. These two, and particularly the procaine injection, seem greatly to reduce the period characterized by edema of the ankle. We have proved this to our own satisfaction by comparing the cases which were not injected, but which were otherwise treated in the same manner, with those receiving injection.

The whole procedure, after the examination, can be done in twenty minutes. The strapping alone can be done in ten minutes. No help is required.

Not only is this treatment efficacious in acute cases, but helps materially in those seen as late as two weeks after injury who are still complaining of pain and swelling. The only explanation we can offer for the gratifying results obtained in those cases in which procaine solution is injected, is that the vicious cycle of (1) pain, (2) decreased use, (3) swelling, and (4) pain, is broken by the elimination of pain.

A typical example of the efficacy of this method of treatment is the following case:

Case No. 6946, a professional baseball player, was first seen on September 5, 1940. He had sprained his left ankle in a night game on September 4, 1940 as he slid into a base. There was considerable swelling of the ankle and ecchymosis on the lateral side of the heel, with pain on inversion and on pressure beneath the tip of the external malleolus and over the lower tibiofibular ligaments. The treatment described was applied. On September 9 the patient played a full nine-inning game.

This method has been used by us in over 500 cases. No incidence of infection has occurred.

THE USE OF PESSARIES*

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THE pessary, an instrument invented to hold the retroposed uterus in forward position and to raise the prolapsed uterus higher in the pelvis, was used extensively in gynecological practice during the prelaparotomy days. As abdominal surgery was developed and its safety increased, innumerable surgical procedures were devised to correct the backward displacements and prolapse of the uterus. During this period of time the service which had been rendered by the pessary was largely forgotten and its use was frequently thought of as an obsolete procedure. As time went on the pessary was rediscovered, so to speak, and, although the indications for its employment are more limited, it now finds a definite field of usefulness in the treatment of the conditions for which it was invented.

In the modern practice of gynecology the pessary is employed chiefly in the following conditions: (1) In uterine retroposition when the uterus is movable; (2) in early pregnancy in a retroposed uterus; (3) in the backward displacements of the uterus following pregnancy and labor; (4) as a trial instrument, before operation, to determine if symptoms attributed to retrodeviation are relieved by elevating the uterus and keeping it in forward position; and (5) in uterine prolapse, especially in elderly women, in whom there exist definite contraindications to operation.

Replacement of the Uterus. The pessary is not intended to change the position of the uterus from posterior to anterior, but rather to hold it in the anterior position after it has been brought to that station by other means. In most instances this may be brought about by bimanual manipulations. When this is not possible, the knee-chest posture, assumed morning and night, and vaginal tamponade may be helpful and may precede the bimanual replacement of this organ. When this is accomplished, a properly fitted pessary will hold the uterus in its correct position. Occasionally the uterus sinks so deeply in the pelvis that it is not possible to replace it bimanually. If a pessary of suitable size is introduced in the vagina and the patient is instructed to assume the knee-chest position morning and night, the uterus may be found in its normal position after a week or two of such trial.

Types of Pessaries in Current Use. The types of pessaries in current use for retropositions are: (1) the Hodge, (2) the Albert Smith, and (3) the Thomas, sometimes referred to as the Smith-Thomas. For prolapse there are, (1) the Raudenbush, also known as the ball pessary, and (2) the Gellhorn pessary. The soft rubber inflated doughnut pessary is not as satisfactory as the Raudenbush and the Gellhorn as it causes a free, and sometimes odorous vaginal discharge, which is objectionable and distressing to the patient.

Hodge Pessary (Fig. 1). This pessary was invented by Hugh L. Hodge, Professor of Diseases of Women in the University of Pennsylvania from 1835 to 1863, and may be considered as the original of the hard rubber retroposition pessaries. It is still used extensively. Its wide anterior end is of value when a deep laceration of the pelvic floor is present.

Albert Smith Pessary (Fig. 2). This pessary is a modification of the Hodge;

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the anterior end is narrowed so that it adapts itself more readily to the narrow portion of the pubic arch, thus preventing the instrument from turning and permitting it to assume a more fixed position.

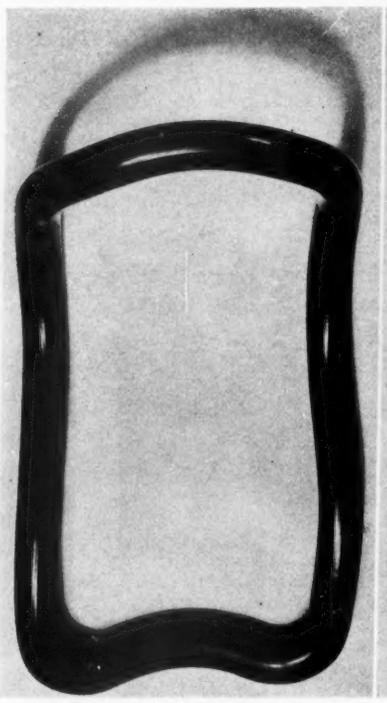

Fig. 1. Hodge pessary.

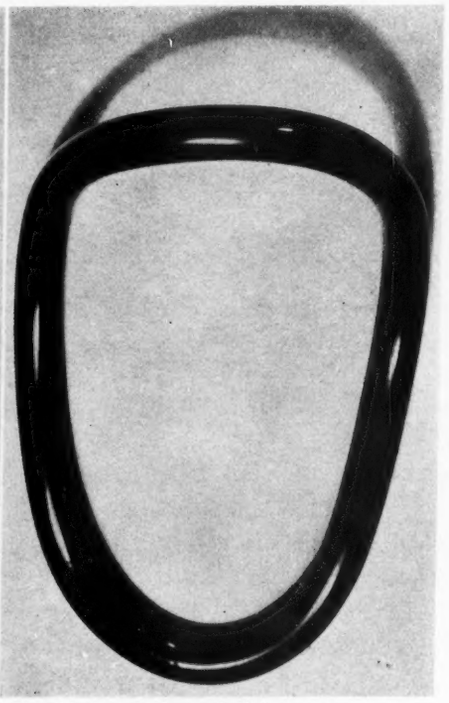

Fig. 2. Albert Smith pessary.

Thomas Pessary (Fig. 3). This is a modification of the Smith pessary by T. Gaillard Thomas, and sometimes referred to as the Smith-Thomas pessary. The posterior bar is thickened and bulbous in character, allowing pressure on a larger surface of the posterior vaginal fornix.

A well fitted retroposition pessary does not interfere with marital relations or with the introduction of a douche nozzle. Indeed, it is not uncommon for women to become pregnant while it is being worn.

Raudenbush Pessary (Fig. 4). This has the appearance of a billiard ball to which a stem has been attached to facilitate its removal. It is made of hard rubber and the ball part is hollow in order to make it light in weight. It may be obtained in three sizes: small, medium and large. When the proper size is applied, a prolapse will be kept reduced in the pelvis. The patient may be instructed in its removal and insertion so that it can be removed at night, cleansed and reintroduced in the morning. In my experience this pessary has been found to be very useful in the management of extensive prolapse in old women when operation is contraindicated.

Gellhorn Pessary (Fig. 5). This is a cup-shaped device with a thick stem which is effective in keeping the prolapsed organs reduced within the pelvis. This instrument is also obtainable in three sizes: small, medium and large. Its greatest field of usefulness is in older women whose physical condition makes operation hazardous. It may be removed at night by the patient and reintroduced in the morning. Its introduction is accomplished by means of a cork screw motion. In the last few years this pessary has become the most popular in the nonoperative treatment of prolapse. More recently it has been made of a plastic material known as neicomold, which is freely boilable, thus assuring perfect sterilization.

The pessary which is employed in the correction of a retroposition must hold the cervix in the hollow of the sacrum.

The important points of support are the pubic arch and the pelvic floor. If it gets adequate support from the pubic arch at its anterior end, the posterior end will elevate the posterior fornix and the uterosacral ligaments. Since the cervix is closely attached to the posterior vaginal fornix, an instrument which supports this structure will bring the cervix well back in the pelvis. As the cervix goes back, the fundus usually assumes a forward position. The size of the pessary is decided by measuring with a ruler or the examining fingers the distance from the posterior vaginal fornix, pushed upward, to the pubic arch, and a pessary slightly less than this measurement is selected. The space between the lateral bars is determined by the width of the vagina. The anterior end is bent downward so that it will not infringe upon the urethra. Several sizes and shapes may have to be tried before a suitable pessary is found.

Fig. 3. Thomas pessary.

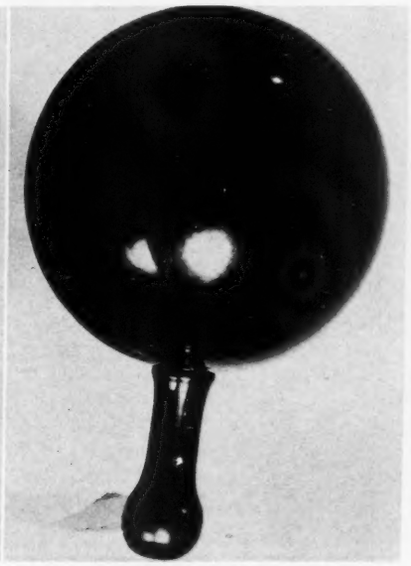

Fig. 4. Raudenbush pessary.

Introduction of Pessary. The patient is in the dorsal position. The uterus has been replaced bimanually. The pessary has been cleansed with a nonirritating antiseptic solution and lubricated with surgical lubricant, (Irish moss jelly). The perineum is depressed with one or two fingers, the pressure being carried in a backward direction to avoid pressing the tissues against the pubic arch, and thereby avoiding pain. The pessary is held by the anterior bar and the posterior bar is introduced in the anteriorposterior diameter—or the widest diameter of the vaginal introitus—in such a way that no pressure is made upon the sensitive urethra. When partly engaged in the vaginal tube, the pessary is rotated so that the posterior bar is directed upward toward the symphysis pubis. With gentle but steady pressure the pessary is directed inward until it reaches the anterior lip of the cervix; the examining finger is passed into the vagina under the pessary and the tip of the finger depresses the posterior bar and guides it inward beyond the cervix. The pessary is now in place, the posterior end behind the cervix, supporting the posterior vaginal fornix and the uterosacral ligaments, and the anterior end behind the pubic arch.

A properly fitted pessary should not be felt and should not cause any discomfort. After a pessary has been fitted, the patient should be asked to walk about the examining room to ascertain whether or not she is conscious of the instrument. If it seems to fit properly, she is instructed to return in a week so that the vagina may be examined for pressure points. If no ab-

normalities are found, the pessary is cleaned, sterilized and reintroduced. The patient is instructed to return after each

Fig. 5. Gellhorn pessary.

menstrual period for inspection of the vagina, cleansing and reinsertion of the support. The shape of the pessary may be altered by dipping it in boiling water, in the sterilizer for instance, and, while it is still soft, shaping it as necessary. The patient is also asked to douche every night in order to remove any vaginal secretion which may have accumulated during the day and to prevent vaginal irritation. A douche which has been found to be satisfactory consists of the compound zinc sulfate powder, National Formulary VI, two or three teaspoonfuls in two quarts of warm water. Inspection of the vagina every two or three months may be all that is necessary in the older woman who is wearing a supporting pessary for prolapse provided it is removed every night. It is of advantage, however, to have those with thin, atrophied vaginal walls return once a month as this type of senile vagina is easily irritated.

Contraindications to the Wearing of a Pessary. The pessary is contraindicated in pelvic inflammatory disease in the presence of an adherent retroversion. Since the uterosacral ligaments are frequently associated with this disorder in the form of a posterior parametritis, the posterior bar of the pessary will cause exquisite pain by constant pressure on these tender structures. It is also contraindicated in prolapsed ovaries as pressure on these sensitive organs will occasion constant discomfort. Obviously it is also contraindicated when the parts are so relaxed that no device will remain in place.

When Should the Pessary Be Discarded? The pessary may be discarded during pregnancy after the uterus has slipped by the promontory of the sacrum and has become an abdominal organ. After labor it usually can be given up at the end of six months, as at that time involution is complete and the ligaments of the uterus have acquired their tonus. When used as a trial instrument, it is obviously discarded after an operative procedure has been performed to keep the organ in normal position permanently. During the childbearing age it may have to be worn indefinitely for retroposition and moderate degrees of prolapse, or until such time as the patient has passed the childbearing age or has reached the menopause, when an operation may or may not be decided upon. Pessaries introduced for inoperable prolapse because of cardiac, renal, vascular or pulmonary complications, are also worn indefinitely, since their removal will allow the uterus again to protrude through the vulva.

SUMMARY

Pessaries find a useful, though limited field in gynecologic practice. Two general types are in common use, those which hold a retroposed uterus in forward position after bimanual replacement, and those which elevate a prolapsed uterus in the pelvis. A properly fitted instrument should cause no discomfort to the patient; it should be cleansed and replaced once a month on an average in order to prevent irritation to the vagina and a daily douche should be applied. The fitting of a pessary is a simple procedure if certain general principles described in the text are followed.

UTERINE HEMORRHAGE*

TECHNIC OF UTEROVAGINAL PACKING

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THE most dramatic emergencies frequently arise in the realm of obstetrics. The outstanding one is a brisk postpartum hemorrhage which occurs with such insidious suddenness that the condition changes from a comparative good one to that of marked shock in the space of a few minutes. Such a situation requires active, intelligent and energetic treatment immediately. The first thought of course is to control the bleeding and combat the shock. If the ordinary simple measures of controlling the bleeding do not suffice, we must resort to uterovaginal tamponade before it is too late. At the same time treatment for shock should be carried out by assistants. In this respect it must be remembered that blood transfusions are excellent for the treatment of a woman who is in shock because of marked loss of blood. An attempt should be made to replace the amount of blood lost; 500 cc. or even 1000 cc. of citrated blood should be administered slowly by the drop method. When the patient has improved, more extensive measures may be instituted with a view to determining the cause and correcting the condition.

In this short article it is obviously impossible to discuss all types of uterine bleeding. The scope of this paper is limited to the severe uterine hemorrhages, which require uterine packing as one of the therapeutic measures, and the technic of uterovaginal tamponade. These hemorrhages may be divided into two main groups: (1) Those occurring with incomplete abortions, and (2) those occurring postpartum. In this latter group we encounter the most sudden and severe hemorrhages which always require prompt and efficient therapy. These will be discussed under the following headings: Lacerations of the cervix, lacerations of the vaginal walls, rupture of vaginal varices, retained placenta with partial separation, inversion of the uterus, placenta accreta and atony of the uterus.

Incomplete Abortion. It is advisable to pack the uterus with gauze in incomplete abortions when the hemorrhage has been severe and alarming, and especially when it is believed that there may be some remnants left after the uterine cavity has been explored gently with a sponge-holder forceps or large dull curet. This serves two purposes: On the one hand it controls the bleeding, and on the other hand the remaining pieces of the products of conception are found on the gauze when it is removed in twenty-four hours. At the Carney Hospital we routinely inject 1 cc. of ergonovine intramuscularly five minutes before removing the gauze in these patients, in order to avoid bleeding and to cause the uterus to contract well.

Lacerations of the Cervix, Vaginal Walls or Vaginal Varices. When the fundus is firmly contracted and the placenta has been expressed intact with the membranes complete, and the woman continues to bleed, the cervix and vaginal walls must be inspected in order to ascertain the cause of the hemorrhage. Good exposure and rigid asepsis is very important. The anterior and posterior lips of the cervix should be grasped individually with sponge-holder forceps because these are less apt to tear the soft friable cervix. If the bleeding is from the lacerated cervix, this should be

* From the Department of Gynecology, Tufts College Medical School, and Gynecological and Obstetrical Service of the Carney Hospital.

repaired immediately with continuous or interrupted sutures using No. 2 chromic catgut. This should be followed by a vaginal pack to the cervix, lateral fornices and vagina. If the bleeding is from the vaginal walls or from ruptured vaginal varices, no attempt at suturing should be made because the tissue is so friable that suturing is unsuccessful and usually produces more bleeding. These situations are handled best by firm vaginal tamponade.

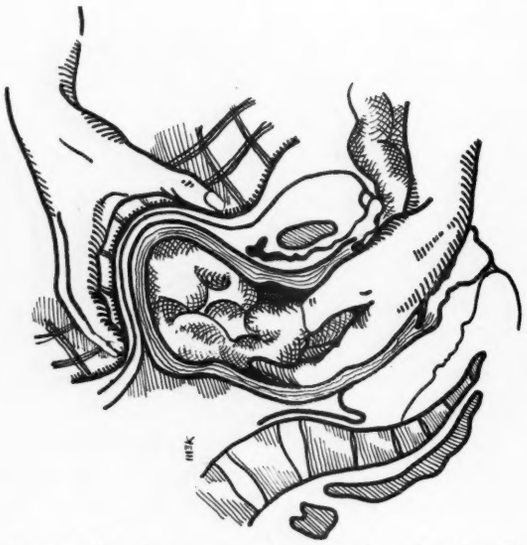

Fig. 1. Packing uterus with hands. The thumb pushes up the gauze for the fingers to pack. (DeLee's "Principles and Practice of Obstetrics"—Saunders.)

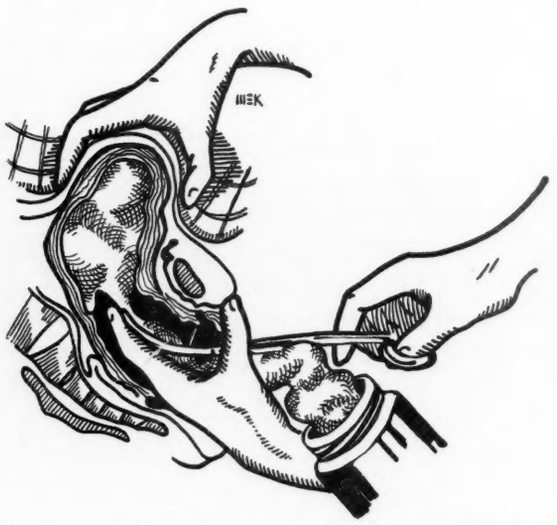

Fig. 2. Packing uterus with uterine dressing forceps. Hand is used as a direction speculum; assistant steadies fundus outside. (DeLee's "Principles and Practice of Obstetrics"—Saunders.)

Retained Placenta. When there is a sudden uterine hemorrhage with the placenta still in the uterus, it may be due to separation of the placenta either partially or completely. If complete, the placenta is easily expressed with the next uterine contraction, which may be hastened by gentle massage of the fundus. If there is a partial separation, the Crede maneuver may be used. However, when we are dealing with a partial separation of an adherent placenta, which cannot be expressed by the Crede maneuver, and when the bleeding is excessive, manual removal should be performed. Titus[1] is of the opinion that this latter procedure should be followed by uterine tamponade for two reasons: first, in order to avoid further hemorrhage which might be caused by uterine atony, and second, to bring away with the gauze any small pieces of placental tissue which may have been torn off during the removal procedure.

Inversion of the Puerperal Uterus. This condition occurs during the third stage of labor or immediately postpartum. It may be complete when the fundus passes through the cervix or incomplete when this does not obtain. The placenta may or may not be attached. The main symptoms are hemorrhage and shock.

Inversion of the puerperal uterus may be divided into acute, subacute and chronic forms. The acute forms are found immediately after delivery and should be replaced manually before the contraction ring forms. These women are in shock and are bleeding and, therefore, these two conditions must be treated immediately before any attempt at replacement is made. Sterile gauze pads should be firmly applied to the inverted uterus, and a solution of 5 per cent glucose in saline should be administered slowly intravenously, while preparations for blood transfusion are being made. When the patient's condition has improved the uterus should be replaced manually and the

uterine cavity should be packed firmly with gauze. Throughout these procedures, rigid asepsis must be maintained because these women resist sepsis poorly due to loss of blood.

The subacute type, described by Kellogg,[2] is one in which the inversion is found relatively soon after its occurrence, but in which the cervical contraction ring has already formed and holds the uterus firmly. His method of treatment is by traction from above during laparotomy, as described by Huntington, Irving and Kellogg.[3]

The chronic type is considered by most authors to be of more than one month's duration. These are treated either by the Spinelli operation, or if complicated by gangrene by abdominal panhysterectomy as reported by Phaneuf.[4]

Placenta Accreta. Placenta accreta is a condition in which the decidua basalis is completely or partially absent and the chorionic villi are in direct contact with the muscle layer (accreta) or dip down into the muscle layer (increta). As suggested by Phaneuf,[5] the term, "placenta accreta," as found in the literature is applied to both pathologic defects.

If the placenta has not separated one hour after the delivery of the child, a diagnosis of an adherent placenta may be made. If the Crede maneuver is unsuccessful and there is no bleeding, the patient may be treated conservatively and returned to bed with a tie on the cord which should be wrapped in sterile gauze. The patient should be watched closely for the placenta may separate spontaneously later. In the presence of bleeding, however, manual removal of the placenta should be performed. If one is dealing with an adherent placenta, the line of cleavage may be readily found and the placenta removed intact. If one cannot find the cleavage and the placenta tears from the uterine muscle, one must assume that a placenta accreta exists. The uterus should immediately be packed with sterile gauze and preparations for transfusion and abdominal supravaginal hysterectomy should be begun. The patient should be given a transfusion before and after the operation if indicated.

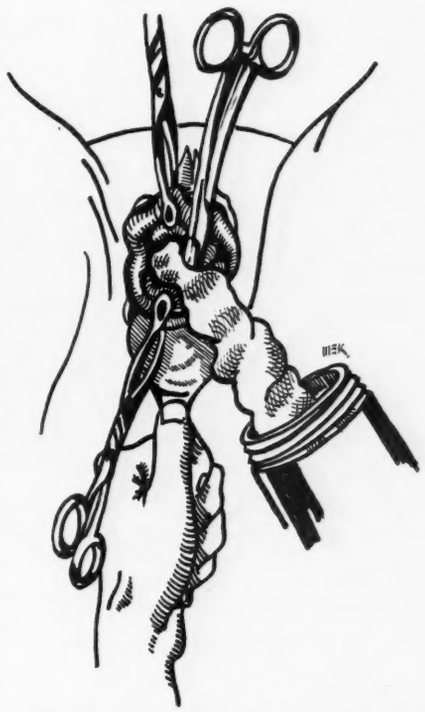

Fig. 3. Packing uterus by sight, instrumental. Sponge-holder forceps on each lip of cervix pull uterus down and straighten it. The assistant's hand controls the fundus to facilitate firm proper tamponade and to avoid perforation. (DeLee's "Principles and Practice of Obstetrics"—Saunders.)

Atony of the Uterus. Atony of the uterus may be due to primary or secondary uterine inertia. The etiology may be overdistension of the uterus from hydramnios, multiple pregnancy or an overdue large baby. Exhaustion from a prolonged labor is a factor also to be considered.

If hemorrhage occurs with the placenta still in the uterus, pituitrin should be administered, 1 cc. intramuscularly, and the fundus massaged. If there is no improvement, the placenta should be expressed during a contraction according to the Crede method. Failing in this, the physician should resort to manual removal. After the placenta is out and bleeding continues, the uterus should be massaged, pituitrin 1 cc. and ergonovine 1 cc. administered intramuscularly or .5 cc. pituitrin

intravenously. If the patient continues to bleed, the uterine cavity should be quickly explored for any remaining placental tissue or membranes or for a placenta succenturiata, and if found removed, followed by immediate firm uterine packing.

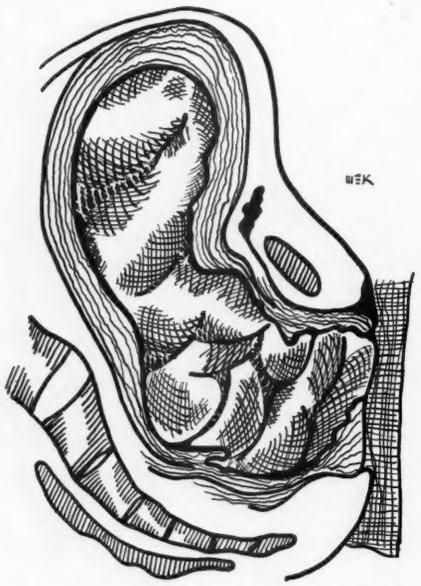

Fig. 4. A uterus correctly packed. (DeLee's "Principles and Practice of Obstetrics"—Saunders.)

Fig. 5. A uterus incorrectly plugged. (DeLee's "Principles and Practice of Obstetrics"—Saunders.)

Other methods which may be used are: (1) Ligation of uterine arteries; (2) clamping of uterine arteries; (3) sewing up the cervix tight over a plug (DeLee); (4) Sehrt aortic clamp; (5) manual compression of the abdominal aorta is of some value while other preparations are being made. This may be performed by the abdominal hand or with the hand in the uterus.

TECHNIQUE OF UTEROVAGINAL TAMPONADE

"Leroux invented uterine tamponade in 1776, Wendelstaedt wrote of it in 1806, but Dührssen popularized it in 1887."[6] In this procedure the first prerequisite is rigid asepsis, because hemorrhage lowers the body resistance against infection; the second is good exposure. The vulva, the inner surface of the thighs, the lower abdominal wall and the anal region are cleansed with ether and are painted with any of the newer antiseptic solutions. Fresh sterile drapes are applied. The urinary bladder is emptied by means of a catheter. Posterior and lateral retractors and occasionally an anterior one are now placed in order to expose the field. The anterior and posterior lips of the cervix are then grasped individually with sponge-holder forceps and brought down. (Fig. 3.) This type of forceps is used because it covers a wider area and does not tear the very friable tissue, as happens very frequently with the ordinary vulsellum forceps. The uterus is then packed firmly from above downwards using a curved uterine dressing forceps. The first portion of the gauze is carried well up to the fundus, which is steadied by an assistant's hand on the abdomen in order to avoid perforation. (Figs. 1 and 2.) In this respect Titus[1] stresses the importance of not removing the point of the packing forceps from the uterus, as is the tendency, but to withdraw it only a short distance grasping the gauze within the uterus and packing and folding it firmly from above downward. This is emphasized in order to avoid seizing the gauze outside the uterus and attempting to push the fold through the narrowed cervical canal, which usually results in an improperly packed uterus, namely, "an un-

packed uterus with a stoppered cervix." After the uterus has been properly packed, the continuation of the same gauze is used to pack the vagina, and as suggested by Beecham,[7] the lateral fornices should receive especial attention in order to cut down the uterine blood supply. It is sufficient to pack the upper two thirds of the vagina. A piece of black silk is then attached to the end of the gauze and the free end of the silk is held to the inner surface of either thigh by means of a small piece of adhesive tape one-half by one inch. This step in technic I have seen used by Phaneuf time and time again and it serves two purposes: It avoids the necessity of entering the vagina when the pack is to be removed and it prevents the possibility of contamination and spread of infection along the gauze from the outside to the vagina. (Figs. 4 and 5.)

Other methods of packing the uterus may occasionally be used such as tamponade with the hand in the uterine cavity, using the same hand to pack the gauze or using an instrument to pack the gauze while the hand is used to direct the gauze in the uterus.

The pack is removed in twenty-four hours and it is advisable to inject intramuscularly 1 cc. pituitrin and 1 cc. ergotrate about five minutes before the pack is removed in order to cause the uterus to contract firmly and thereby prevent further loss of blood. The gauze used may be plain, iodoform 5 per cent, or ½ per cent moist lysol gauze. The latter is recommended by DeLee. Various concerns put up this gauze in sterile sealed jars or tubes. The sizes vary, some use gauze one yard wide by five yards folded to a three inch width. Others have eight inch by ten yards folded to a one inch width. Either size or type of gauze may be used.

SUMMARY

Severe uterine hemorrhages which require uterovaginal tamponade as one of the therapeutic measures are discussed under the following headings: Incomplete abortions, postpartum lacerations of the cervix, vaginal walls and rupture of vaginal varices, retained placenta with partial separation, inversion of the puerperal uterus, placenta accreta and atony of the uterus.

The outstanding symptoms in all of these conditions are hemorrhage and shock. It is emphasized that the hemorrhage must be controlled and the shock combatted before any other extensive operative procedures are instituted. In this regard it is noted that blood transfusions are excellent therapy for shock due to loss of blood, and should be used in addition to the other usual methods of shock treatment.

The technic of uterovaginal packing is described and illustrated, with stress on rigid asepsis.

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LEUCORRHEA*

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EXCESSIVE vaginal discharge is the chief "minor ailment" in gynecology. When this secretion is abnormal in amount, odor, color or causes itching or irritation, it may be assumed to be the symptom of some pelvic disturbance, either functional or organic.

HISTORY

A careful history is of prime importance. Was the onset acute? Did it follow questionable sexual contact, or recent marriage? Is there burning micturition and vulval irritation? If these questions are answered in the affirmative, a gonorrheal infection is suggested. Is there itching and creamy or frothy discharge in a virgin? Or pruritus with dyspareunia in a married woman whose husband, is above suspicion? Trichomonas vaginalis or yeast infection is probably responsible. If the patient is pregnant, the probability of one of these latter conditions is increased.

CHARACTER OF THE DISCHARGE

The appearance of the secretion often gives a clue to the etiology. A blood tinged discharge, especially in women over 40, means cancer until proved otherwise. Cervical polypi, submucous fibroids or hyperplasia of the endometrium may also cause a mucosanguineous type of leucorrhea.

A clear mucous, viscid or thin, milky, nonirritating issue, suggests erosion of the cervix, pelvic congestion or retrodisplacement of the uterus.

The trichomonads usually produce a frothy, bubbly or thick, creamy fluid; while the yeast organisms may form crust-like plaques on the vaginal wall. A cheesy, crumbly discharge may also result from a monilia infection. A yellow discharge is often due to gonorrhea but may result from a nonspecific endocervicitis, senile vaginitis or pyometra.

A foul odor means either a foreign body or necrosis. Porous, soft rubber pessaries are old offenders and should never be used. Recently the writer removed a menstrual tampon that had been retained for several weeks, and a colleague found the same type of foreign body in a patient referred with a diagnosis of carcinoma of the cervix. Sloughing fibroids or cancer will also cause an offensive odor.

A sudden gush of pus from the vagina usually follows expulsion of an accumulation in the upper vagina. Rupture of an infected Bartholin gland or more rarely sudden evacuation of a pelvic abscess can produce the same effect. It is a common fallacy that pus tubes may drain suddenly into the vagina. This is impossible as the isthmus becomes occluded soon after the onset of salpingitis.

In infancy and childhood the discharge is usually confined to the vulva and lower vagina. The parts may be swollen, red and bathed in pus. A Neisserian infection should be carefully searched for, but more frequently yeast organisms or the common pyogens—Staphylococci, Micrococcus catarrhalis, or Bacillus coli—will be found. Lack of cleanliness, a strongly acid urine, intestinal parasites, masturbation or a spread of infection from the respiratory tract should be considered.

DIAGNOSIS

Careful inspection of the vulva, vagina and cervix with a thorough bimanual examination should reveal the source of

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the discharge. The urethra should be gently stripped under the symphysis and Skene's glands compressed. A loop of secretion should be taken from the urethra, vaginal fornix and cervix. Diluted with a few drops of saline solution this is studied under the microscope for trichomonads and yeast organisms. Staining for bacteria should then be done. A careful urinalysis should be performed in all cases, particularly when pruritus exists, to rule out glycosuria.

TREATMENT

If the gonococcus is found in an acute infection, the patient should be put to bed or hospitalized and a thorough course of the new chemotherapeutic drugs given. In the chronic cases the writer's results with these agents have not been so encouraging. In these the foci in Skene's glands, the urethra and endocervix must be eradicated. Whether the endocervicitis is specific or nonspecific, the deep racemose glands cannot be reached by topical applications; and is palliative methods fail, the infected endocervix must be destroyed by the electric cautery or removed by conization or the Sturmdorf operation.

As the endocervix is usually the source of the leucorrhea, vaginal douching merely removes the accumulated secretion and makes the patient comfortable for a time. In trichomonas infections, however, a true vaginitis exists and douching may effect a cure. Solutions for this purpose should always be nonirritating. Mild cases may respond to the popular vinegar douche (four tablespoons to two quarts warm water) or lactic acid (1 dr. to the quart) or 25 per cent salt solution. The patient should always be instructed to irrigate the vagina in a reclining position on a bed-pan or in the bath tub and a return flow douche-tip should be used. This has a rubber shoulder which fits snugly against the vulva permitting a thorough distention of the vaginal folds.

A variety of powders, tablets and suppositories has been developed for trichomonas vaginalis infection. These are particularly useful in pregnancy when douching is inadvisable. It is usually not possible to cure this type of infection during pregnancy but the symptoms may be relieved and the patient's comfort maintained. Treatment also controls the infection so that puerperal morbidity is not increased.

Stronger douche solutions such as mercuric chloride 1:4000 (best taken in the morning so that the fluid will not be retained), potassium permanganate 1:4000 or formalin 1 dr. to the quart, may be necessary in the more resistant cases. Infections that relapse repeatedly may have a bladder involvement that should be cleared up by urinary antisepsis. Making the urine strongly acid or alkaline kills the flagellates. If this fails, the writer has had excellent results with neo-prontosil tablets 5 gr. q.i.d. Skene's glands or the husband's prostate may harbor the organism.

Patients react differently to the various types of treatment developed for trichomonas vaginalis vaginitis. They all relieve the symptoms promptly but no method devised up to now will surely cure.

Yeast vaginitis usually responds promptly to a 1 per cent aqueous solution of gentian violet. The vaginal walls are thoroughly painted with this solution three times a week. Each morning an antiseptic douche such as hexylresorcinol 1:1000, merthiolate 1:1000 or metaphen 1:500 should be used. In the last month of pregnancy every effort should be made to cure the infection to prevent the development of thrush in the infant.

Leucorrhea caused by erosion or laceration of the cervix may be temporarily relieved by an astringent solution. An excellent one for this purpose is compound zinc powder (N.F.) 1 dr. to the quart. The cautery should be used to cure erosions and to assist in the epithelialization of minor lacerations. When the latter are extensive, a trachelorrhapy or amputation of the cervix should be done.

SUMMARY AND CONCLUSIONS

Although leucorrhea may be classed as a *minor* ailment, it is frequently a *major* annoyance to the patient. A search for the cause and cure will frequently tax one's diagnostic ability and therapeutic ingenuity. A form of treatment which relieves one patient may not help another with a similar condition. It should be borne in mind that in most cases of long standing leucorrhea, the fons et origo of the discharge lies in the endocervix. No cure can result until this infected tissue is destroyed or removed.

In obtaining cultures from the more accessible portions of the female tract, such as the urethra, cervix, vulva or vagina, it is well to remove surface material and obtain the cultures direct from the membrane itself. From—"Office Urology" by P. S. Pelouze (W. B. Saunders Company).

NON-INFLAMMATORY NODULES IN THE FEMALE BREAST*

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As the lay public becomes increasingly tumor-conscious, physicians are consulted by many patients complaining of nodules of the breast and thyroid, lesions of the face, trunk and extremities which cause worry because of the possibilities of cancer. Obviously, public education serves the admirable purpose of bringing to the physician's care lesions at any early and perhaps curable stage. In the past, the diagnosis and palliative therapy in cancer was simple, since the overwhelming majority of cancer patients came under observation during the advanced stages of the disease. This state of affairs is now changed. Practitioners are seeing an increasingly large proportion of lesions at so early a stage that their nature is often in doubt. Intelligent handling of these early cases demands an intimate working knowledge of the basic pathologic changes to which these tissues are subject. This paper is an attempt to present in a simple and workable fashion the fundamental pathologic principles that are essential to the rational treatment of the non-inflammatory breast lesions. Clinical pictures will be discussed only to correlate with their pathologic basis. Therapy will in most cases be only mentioned.

The mammary glands, each composed of twelve to fifteen glands, function by producing secretions which are carried through a duct system to the nipple. Structurally each of these glands is composed of a large duct, its branches, and the terminal ducts and acini. The functioning unit or acinus is lined by a layer of cuboidal epithelial cells directly under which is a layer of loose subepithelial fibrous tissue. A single layer of smooth muscle cells surrounds the subepithelial layer and separates it from the more abundant periductal and periacinar connective tissue that surrounds the glandular clumps and serves to define them from the coarse collagenous fibrous stroma of the breast. Grossly the normal adult breast then is composed of fat and pearly white fibrous stroma stippled with slightly raised salmon-pink bodies. The latter are the functioning gland groups of ten to twenty acini. Until puberty this gross picture is modified because the parenchyma consists only of ducts.

Physiologically the proliferative and secretory activities of the breast are apparently under the control of the corpus luteum of the ovaries and the placenta hormones. At puberty under the influence of the functioning ovary the breast tissue undergoes a proliferative phase that is identical with the more exaggerated process that occurs in pregnancy. This physiologic proliferative process is frequently the cause of the breast discomforts of puberty, menstruation and pregnancy.

With this knowledge of breast structure and activities in mind, it is apparent that the large percentage of non-inflammatory breast nodules are only abnormal reactions of epithelium and connective tissue. These may each be considered under their hyperplastic and neoplastic reactions.

EPITHELIUM

1. *Desquamative Epithelial Hyperplasia.* The energies of breast epithelial cells are divided into performing their secretory functions and reproducing. If the reproduc-

* Presented to the Snohomish, Skagit and Whatcom County Medical Societies, June 12, 1939.
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tive activities are excessive but within normal limits and the epithelium retains some function and is not infiltrating, the epithelium is considered hyperplastic. This hyperplasia of breast epithelium is frequently termed desquamative epithelial hyperplasia because many of the cells are performing their normal function of desquamation into the lumen. Desquamative epithelial hyperplasia with new duct and acini formation, accompanied by a hyperplasia of the mantle of periacinar and periductal connective tissue and lymphocytic infiltration is a normal physiologic proliferative process *only* at birth, puberty, menstrual periods and pregnancy. If this normal proliferative process occurs at any other time the condition is termed chronic mastitis. Because this term implies the misconception that the condition is fundamentally an inflammatory one Cheatle and Cutler[6] have recommended substituting the term *mazoplasia.*

A second disease entity that is primarily a desquamative type of epithelial hyperplasia and accompanied by the same changes noted above differs in that the biologic activity of the epithelial cells does not end with desquamation but goes on to cyst formation. This condition, which is never physiologic or inflammatory in origin, is usually called chronic cystic mastitis. Cheatle and Cutler have suggested the term cystiphorous desquamative epithelial hyperplasia.

(*a*) *Chronic Mastitis or Mazoplasia.* It has been noted that this completely benign condition is fundamentally a normal physiologic proliferative process occurring at an abnormal time. The biologic activity of the epithelial cells in this condition is limited to desquamation. The correct diagnosis of chronic mastitis or mazoplasia positively excludes the presence of cysts and papillomas, and the condition is never a precancerous lesion. Mazoplasia or chronic mastitis is almost universally present in the same breast with papillomas, carcinomas, or cysts, but careful search by many investigators has failed to reveal any microscopic indication of a transformation of the desquamative epithelium into neoplastic or cystic conditions.

The outstanding subjective symptom is a diffuse aching pain over one or both breasts that is often exaggerated at the time of menstruation. Many of the patients have short, scanty menstrual periods as additional evidence of domination of the corpus luteum. There is no interference with the normal contour of the breast. To palpation, the gland is wholly or in part more solid than usual, and often a fine nodularity is detected throughout. There is no nipple discharge.

Treatment is primarily the positive diagnosis of the condition and exclusion of other lesions, by biopsy if necessary. Palliative therapy consists of rest, mechanical support, and ovarian substances, as ovarian residue, etc., to counteract the dominating control of the corpus luteum hormone. *Prolonged hopeful medical treatment of the suspected breast nodule without accurate biopsy diagnosis is extremely hazardous and ill advised.*

(*b*) *Chronic Cystic Mastitis or Cystic Disease of the Breast (Cystiphorous Desquamative Epithelial Hyperplasia).* In this second type of desquamative epithelial hyperplasia, the biologic activity of the hyperplastic epithelial cells is not completely spent in desquamation but tends to cyst formation. Chronic cystic mastitis may coëxist with the rather universal chronic mastitis, but is entirely separable in its etiology, symptomatology, pathology, prognosis and treatment. The clinical importance of chronic cystic mastitis is intimately concerned with the possible complications of the cyst, e.g., stagnation and tumor formation.

The possible relationship between cystic disease of the breast and cancer is obviously of great import, but is highly controversial. Delbet[10] and Bloodgood[1] represent a large body of surgical opinion in stating that the condition is too benign to justify extirpation and that the association between chronic cystic mastitis and carci-

noma is very rare. This conclusion is based on their observations that characteristic cases pursue a chronic course without any neoplastic complication.

Against this view stands the interpretation of the majority of pathologists, including Cheatle and Cutler,[6] Ewing,[12] Schimmelbusch,[15] and Boyd[3] that the character of the tissue change in chronic cystic mastitis is such that the change to carcinoma is easy. Advocates of this viewpoint feel that cystic disease of the breast should be considered and treated as a highly important precancerous lesion. Cystic formation predisposes to stagnation of the contents of the ducts and acini. Irritating stagnant contents may, if undisturbed over a period of years, lead to an irritative hyperplasia of the lining epithelial cells or to a benign neoplasia (papilloma). Cystic disease of the breast with papilloma formation has been termed Schimmelbusch's Disease. The step from a benign neoplasia (papilloma) to a malignant neoplasia (cancer) does occur in some cases.

Not all cases of cystic disease of the breast pursue this course of events. The disease *may become arrested* at the cystic or papillomatous stage, or may actually regress. The frequency with which this disease *may* progress to the benign and later malignant neoplasia stage is difficult to estimate, but is approximated at 10 to 15 per cent. Cheatle and Cutler conclude from a study of their material that 20 per cent of the cancers of the breast arise by this sequence, e.g., progressing from cysts to papillomas to carcinomas. Ewing[12] and Verga[16] state that about 50 per cent of their cases of chronic cystic mastitis show pronounced precancerous changes or miniature carcinomas.

The disease usually develops in one breast and often later in the other. The onset and progress are slow and often painless and the condition may not be recognized until a cyst of some size attracts attention. There may be a golden brown or green black fluid discharged at the nipple. A bloody nipple discharge usually, but not always, indicates a papilloma or carcinoma. The examiner finds that the breast of such a patient may contain numerous cordlike structures and multiple swellings with great irregularity of structure. Transillumination, as suggested by Cutler,[7] may infrequently substantiate the impression gained by physical examination that the condition is a cystic disease of the breast.

The clinical distinction between uncomplicated cystic disease of the breast, cysts with papillomas or carcinomas, and carcinoma of the breast, is often extremely difficult. Usually biopsy and frozen section examination are necessary. At surgery the entire suspicious region should be removed wide of the lesion. Grossly the tissue in chronic cystic mastitis will present a pattern of dirty gray or bluish gray firm fibrous tissue studded with cysts. The cysts may be small and numerous, or large and infrequent. From the smaller cysts worm-like putty, gray casts (butter cysts) may be expressed. Large cysts when unopened may have a bluish tint that suggested to Bloodgood the term blue-domed cyst. The contents of the large cysts may be clear straw-colored fluid or much caseous fatty material. Especially should the clinician and pathologist examine the tissue for unusually firm, pearly gray, finely granular regions—indications of malignancy.

Further treatment of the condition, if no cancer exists, has been well discussed by Cutler and Buschke.[9] They feel that the decision must be made in each case and guided by individual factors, such as family history of carcinoma of the breast, the patient's attitude in wishing to accept the *possibilities* of breast cancer rather than mastectomy, etc. The patient's coöperativeness and opportunities for periodic postsurgical "check-up" examinations of the breast are additional factors influencing the surgical course. Cystic disease of the breast with localized papilloma formation (Schimmelbusch's disease), often termed cystadenoma, is considered an indication for local mastectomy because of the ease of transformation to cystadenocarcinoma.

11. *Epithelial Neoplasia.* If the reproductive activities of the breast epithelial cells are excessive, remaining viable and capable of further reproduction instead of performing their primary function of desquamation, the epithelium is considered to be neoplastic. Frequently this distinction between hyperplastic and neoplastic epithelium is extremely difficult. The further differentiation of benign from malignant lesions is and should be based on a combination of the clinical and histologic findings. In the usual case it cannot be emphasized too strongly that the microscopic findings should be interpreted only in the light of the clinical picture. In some cases the microscopic findings are all-important and alone establish the diagnosis, prognosis and treatment. In other cases, however, they must be discarded in favor of the clinical data; Ewing's expression, "microscopically malignant, clinically benign" illustrates this concept neatly.

Cheatle has declared that the only absolute microscopic evidence of carcinoma of the breast is the presence of actively multiplying cells outside their normal boundaries of ducts and acini. Epithelial cells with all the morphologic characteristics of malignancy but which are still confined within normal boundaries are, according to Cheatle, to be considered as precancerous lesions.

Benign Epithelial Neoplasms. (*a*) *Papilloma.* The simplest papillomas are benign tumors composed of stalks of vascular connective tissue covered by epithelial cells. They may occur in the ducts or acini, but duct papillomas with stalks of periductal connective tissue are most frequent. Those with a single stalk are termed uniradicular, those with multiple stalks, multiradicular. There is a tendency for all papillomas to develop alveoli of various shapes in an attempt to create new glandular elements of duct and acini. These, depending on their appearance, are qualified as adenopapilloma, intracystic papilloma, etc. A more important type of papilloma in its precancerous capabilities is the sessile variety in which there is a piling up of cells in a papillary formation.

These soft yellowish tumors vary markedly in size and consistency. Studies of whole microscopic sections of the breast disclose the fact that these tumors are more frequent than is generally supposed and are frequently multiple. If only a single papilloma is present it is usually found in the duct of the nipple, ampulla, or one of the large main ducts. Multiple tumors are usually unilateral but occasionally they may occur in both breasts.

The classical clinical sign is a serous or serohemorrhagic nipple discharge. Usually this discharge is intermittent and frequently confused with the similar discharge from trauma or carcinoma. *Pain* is a frequent symptom if hemorrhage distends the duct. A palpable tumor is now rarely found because patients are first examined at the time of early nipple discharge. Gentle pressure and transillumination are the methods used to localize the lesion.

As in papillomas of the colon and urinary bladder, carcinoma may supervene on papillomas of the breast, but increasing evidence indicates that the time interval of this malignant change may be extremely long. Since there is no clinical method of determining whether or not the malignant transformation has already occurred, or to predict its time of occurrence, all papillomas of the breast should be regarded as potentially malignant. The extreme view, according to some surgical pathologists, is to regard the whole breast containing a papilloma with suspicion. Cutler and Buschke[9] summarize treatment, using a composite of many criteria, including the degree of anaplasia of the cells in the removed specimen, the age of the patient, history of cancer in the family, findings of transillumination, size of the lesion, psychologic reaction of the patient to breast amputation, etc.

(*b*) *Adenoma of the Breast.* Pure adenomas of the breast are extremely rare and are merely mentioned here. They are

composed almost entirely of glandular elements and are frequently described as "fetal adenomata." Their course resembles that of the fibroadenomas except that they may be first noted as rather rapidly enlarging benign tumors during pregnancy. Frequently they are only diagnosed histologically in a tumor removed as a fibroadenoma.

2. *Malignant Epithelial Neoplasia—Cancer of the Breast.* In spite of the frequency, accessibility, and importance of breast cancer, progress in this field is extremely slow and discouraging. Surgeons and pathologists alike are so bewildered by the variety of anatomic and histologic patterns of the disease, and by the varying clinical courses individual cases may pursue, that too frequently the whole group is classed together, as carcinoma of the breast. Equally less illuminating are the older attempts to classify the malignant epithelial lesions into carcinomas of the solid, simplex, medullary, and scirrhous types.

Chief among the difficulties in any rational grouping of these lesions is the fact that once the tumor has begun to spread within the breast numerous events alter its morphologic and microscopic appearance. The urgent need is for a classification based on anatomic and histologic types which physicians can associate in some way with the clinical types, considering frequency, course, prognosis, and the therapy indicated. Ewing[12] and Cheatle[6] have done important pioneer work in this field by offering just such a classification—admittedly not perfect, but at present the best offered. For a more complete consideration of this subject, reference should be made to the works of Cheatle and Ewing.

Carcinomas of the breast may arise in one or more of four primary locations: (1) in the main branch of the duct near the nipple; (2) in the midportion or the duct unit, that is, in one of the smaller branches; (3) in a terminal duct and acinus; and (4) in the entire duct system.

The primary tumors in each of these locations may be modified in their clinical, pathologic, and histologic features by any of four events in varying degrees, namely: *anaplasia, gelatinous* or *mucoid degeneration, fibrosis,* and *comedo formation.* It is interesting to note that in a general way the malignancy of breast cancers increases as one goes peripherally from the nipple.

(*a*) *Papillary Adenocarcinoma of the Breast.* These are the large, firm, often encapsulated, growths in a large duct behind or near the nipple. Frequently they are thought to arise in a cyst that over a long time period has passed through the papilloma stage to the malignant one. In later stages these cysts frequently occupy a large portion of the breast, but still without lymph node metastasis. Important clinically is that in the later stages of the disease there is a marked discrepancy between the apparent seriousness of the disease and its comparatively favorable prognosis.

(*b*) *Carcinoma Developing on the Basis of Cystic Disease and Schimmelbusch's Disease.* The relative frequency of this type has been noted by some authors[7] as approximately 20 per cent of all carcinomas of the breast. Ewing[12] states that the majority of mammary carcinomas present themselves under these situations.

Cheatle[6] separates this type into two subgroups. The first usually arises from one duct and its acini, and demonstrable cystic disease of the breast, generally complicated by papillomata formation (Schimmelbusch's disease), is present. At some region in this mass of cysts and papillomas, carcinoma may develop. These patients usually give a long history of cystic disease and frequently have undergone one or more operations for the removal of such cysts. Often there is a history of nipple bleeding due to duct papilloma. Finally the clinical and pathologic evidence of the supervention of carcinoma is noted.

In the second subgroup, cystic disease may or may not be present. The carcinoma develops in a terminal duct and its acini, with no predilection for previously altered

tissue. These tumors are usually small, firm, opaque, and extremely malignant. They belong to the so-called anaplastic type of carcinoma. In these cases the history is short. There may be no evidence of preëxisting cysts or bleeding from the nipple, without gross or microscopic evidence of a precancerous state. Because of its frequency in young patients the lesion is often misinterpreted as benign.

(*c*) *Diffuse Duct Carcinoma.* In this variety the epithelial lining of several ducts and frequently the entire duct system are involved in the neoplastic process. The breast is enlarged and diffusely indurated. In the advanced stages, the skin, nipple, and whole mammary gland may be markedly thickened. To palpation there may be no discreet tumor mass. This is a highly malignant form of mammary carcinoma with early invasion of lymph nodes and a consequently unfavorable prognosis.

In the *comedo* variety of duct carcinoma the mammary gland undergoes a diffuse fibrosis with considerable shrinkage. Grossly the entire duct system is involved, but dilated ducts are filled with necrotic debris. Microscopically the lining epithelium is neoplastic but the lumen is distended and filled with degenerating epithelial debris. Bloodgood particularly recognized the relatively benign nature of this form of mammary cancer.

Surgery continues to occupy a prominent place in the treatment of mammary carcinoma. As patients consult their physicians earlier the proportion of clinically doubtful tumors increases, with the indications for exploratory operations correspondingly increased. Diagnostic biopsies in dealing with practically all tumors should, when practical, be replaced by therapeutic biopsy, in which the entire lesion is gently removed with adjacent healthy tissue. In many carcinomata radiation therapy is combined with the radical surgical procedure and in exceptional instances may be substituted for it.

Ewing summarizes nicely the general feeling that the chief hope for a reduction in the mortality from mammary cancer lies in its prevention and earlier diagnosis. He feels that both these objectives point to the excision of many breasts before carcinoma has become established in the clinical sense. The growing tendency to remove the breast for recognized chronic cystic mastitis, Schimmelbusch's disease or suspected carcinoma, while probably sacrificing some organs unnecessarily, has justified itself in his opinion by securing the early removal of some miniature carcinomas and more precancerous lesions.

Under the malignant neoplasias one may also discuss the interesting disease entity described by Paget[14] in 1874, and designated as Paget's disease of the nipple. This clinical syndrome is distinct and classical, but the underlying nature of the pathologic process is highly controversial.

Paget originally described the process from clinical observation alone as a superficial lesion that is often followed by a carcinoma of the underlying breast tissue. More recent studies by Muir[13] and Shaw Dunn[11] have led to the opinion that carcinoma in the upper ducts is commonly present when the disease first comes under observation, in which case carcinoma does not follow, but causes the surface disease.

Paget's disease of the nipple is unilateral. It begins on the surface of the nipple as a chronic, slowly progressive, eczematous, often dry, red and scaly lesion. It spreads slowly to involve the areola and finally causes a flattening of the nipple. Axillary glands are practically never involved until late in the disease. Carcinoma of the underlying breast almost invariably accompanies the surface lesion although frequently difficult to detect by clinical methods.

Characteristic of this condition histologically are the edematous vacuolated neoplastic Paget's cells found in the epidermis, the malignant-appearing neoplasia of the epidermis of the nipple, and the adjacent large ducts in some of which frank cancer may be present.

Treatment is as debatable as the nature of the underlying pathologic process. Since

one can never be sure clinically of the condition of the axillary glands, Cheatle and Cutler and Bloodgood are emphatic in their opinion that radical mastectomy is the only treatment to be employed. Others feel that if there is no gross disease of the axillary glands local mastectomy is curative.

CONNECTIVE TISSUE

The abnormal reactions of connective tissue may similarly be considered under their hyperplastic and neoplastic reactions. Connective tissue hyperplasia affects the breast diffusely and there is no localized growth. Important hyperplasia of connective tissue has been considered in connection with the epithelial hyperplasias.

Connective tissue neoplasia of the breast is a localized process, usually with a decided epithelial element. These neoplasias are subdivided into the benign and malignant varieties.

1. *Benign Connective Tissue Neoplasia.* (*a*) *Fibroadenoma.* These are benign, usually encapsulated, connective tissue tumors with a decided epithelial element. Pure fibromas of the breast are a rarity. Fibroadenomas are classified into the subepithelial intracanalicular fibroadenomas, and the pericanalicular and periacinar types, depending on the region of origin of the connective tissue element. Tumors having both subepithelial and periacinar and periductal connective tissue constituents are usually classified as mixed tumors.

Clinically these tumors are very common and are frequently present without clinical signs. Rarely do they develop before puberty. Between puberty and the age of 25, they are usually of the periductal and periacinar types, constituting the most common tumor of the female breast. They are firm, round, solid, often lobulated, freely movable and well circumscribed nodules. The rate of growth varies. Rarely do they cause pain. They may become extremely large by direct growth or cystic changes, and by malignant sarcomatous transformation. The latter is thought to occur in about 5 to 8 per cent of the cases. Rapidly growing fibroadenomas frequently appear microscopically malignant but are clinically benign as proved by absence of metastases and survival of the patient.

Treatment is their surgical removal. All such operations should be performed with the thought in mind of the possibility of an error in diagnosis.

11. *Malignant Connective Tissue Neoplasia—Sarcoma.* Sarcoma of the breast constitutes approximately 4 per cent of the breast tumors. This apparently high estimate is probably accounted for by the fact that in the past many highly anaplastic carcinomas have been incorrectly considered as sarcomas. The most common type of sarcoma of the breast is that in which the malignant transformation of the connective tissue is accompanied by epithelial elements, adenosarcoma. Pure sarcoma of the breast without any epithelial elements is extremely rare.

(*a*) *Adenosarcoma.* The ultimate character of an adenosarcoma of the breast depends largely upon whether the connective or the epithelial elements assume the leading and dominating rôle. The largest sarcomas are those in which the epithelial changes are marked. Microscopically the connective tissue is frequently myxomatous. Clinically it is a disease of later life, usually occurring between the ages of 40 and 50 years. The spindle-cell variety develops earlier in life than the round-cell type. The first clinical sign is usually a single breast nodule, or, more rarely, multiple nodules in one breast. Pain is a late symptom and more common in the cystic forms with epithelial activity. Nipple discharge is infrequent.

A chief characteristic of sarcoma of the breast is a tendency to local recurrence. The axillary glands are rarely invaded, distant metastases being more common.

Treatment consists of surgery and radiation. The prognosis varies with the type, the cystic forms being less malignant than the solid variety. Radiation is of most value when the tumor is composed of round cells.

(*b*) *Pure Sarcomas.* These breast tumors are extremely uncommon and clinically indistinguishable from adenocarcinoma of the breast.

MISCELLANEOUS TUMORS OF THE BREAST

Tumors occasionally found and only to be mentioned are: any of the benign or malignant tumors of the epidermis, sebaceous, and dermoid cysts, lipomas and angiomas.

SUMMARY

1. Intelligent handling of the non-inflammatory breast nodules in the female breast demands an intimate working knowledge of the basic pathologic changes to which this organ is subject.

2. An attempt has been made to present in a simple and workable fashion the fundamental pathologic changes of the non-inflammatory breast nodules in the female breast.

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A CONSIDERATION OF UTERINE PROLAPSE AND RELATED CONDITIONS*

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GYNECOLOGIC HERNIAS

IT is important to recognize that uterine prolapse, cystocele, urethrocele, enterocele and rectocele are all hernias, and that in their treatment one must follow the same surgical principles employed in the repair of hernias elsewhere in the body.

Gynecologic hernias occasionally develop in nulliparous women as the result of congenital weakness of the pelvic muscles and fascia, and an exceptionally deep cul-de-sac of Douglas; but for practical purposes, the causative factors may be considered to be the stretchings and lacerations incident to parturition and increased intra-abdominal pressure. As in the treatment of all hernias, the most satisfactory time to repair those of a gynecologic origin is as soon as possible after they occur, before muscles and fascia retract and become atrophied from lack of use. In other words, few gynecologic hernias would develop and few extensive operations would be required for procidentia and related conditions if injuries incident to childbirth were repaired at the time of occurrence or soon afterward.

I often hear a woman say that she knew she was lacerated at the time of her first labor, but that her doctor at home had advised against any surgical intervention until after she had definitely decided to have no more children. If a few well placed stitches could be inserted after each labor complicated by lacerations, few radical or extensive operations would be required in women at or past the age of the menopause. There is no doubt that obstetricians today realize the importance of puerperal gynecology, but Richardson has stated that "Recent reports from some of our best obstetrical clinics reveal that late follow-up examinations disclose unsatisfactory conditions of the cervix and lower birth canal in from 50 to 75 per cent of women who have borne one child or more."

Arriving at a diagnosis of gynecologic hernia is not all that is necessary in advising treatment. We must also have some idea of the size of the hernia; grading it in degrees from 1 to 4, as its size indicates, is a genuine aid. In many cases in which the protrusion should be graded 1, no treatment is indicated, because many of these hernias change but little as time passes; however, if the patient is examined again after one year's time and the cystocele, descensus uteri or rectocele can at this time be graded 2 or 3, such an increase would constitute definite evidence that the hernia is a progressive condition and that nothing could be gained by delaying treatment.

CAUSATIVE FACTORS IN URETHROCELE, CYSTOCELE, RECTOCELE AND UTERINE PROLAPSE

Urethrocele and cystocele are the result of lacerations of the anterior vaginal wall involving the urogenital diaphragm; they are also caused by lack of support as the result of stretching or tearing of the perineal body or the levator ani muscles. Rectoceles are the direct result of lacerations of the posterior vaginal wall involving the levator ani muscles or the perineal body; they may become large even when there is little or no injury to the skin of the perineum.

* Read before the third annual meeting, New Orleans Graduate Medical Assembly, New Orleans, February 6, 1939.

Uterine prolapse is the result of lacerations of either the anterior or posterior vaginal wall, or more frequently of both,

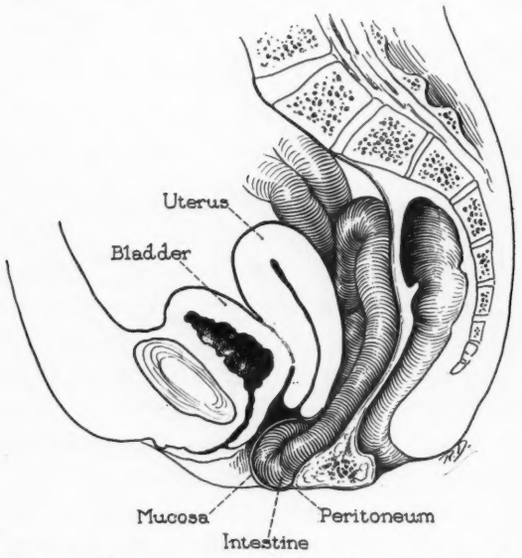

FIG. 1. Posterior vaginal hernia or enterocele (true gynecologic hernia), showing presence of a definite peritoneal sac.

associated with tearing and stretching of other uterine supports, especially the cardinal or Mackenrodt ligaments. Retrodisplacements of the uterine fundus always hasten descensus; in fact, neglected cases tend toward the development of procidentia, which is a condition of prolapse in which the entire uterus extrudes from the introitus vaginae. In many cases of descensus uteri, and particularly in cases of procidentia, undesirable changes take place in the uterus. These changes are especially evident in the cervix uteri, where they are usually the result of hyperplasia and edema, caused by venous congestion and infection. In many cases in which the cervix protrudes through the introitus vaginae, ulcers develop as the result of irritation arising from rubbing on the skin of the thighs, or from vulvar pads. Although malignancy has been reported accompanying or proceeding from some of these rather common ulcers, it is a change rarely encountered.

THE TRUE GYNECOLOGIC HERNIA

All the conditions heretofore considered are actually false abdominal hernias because there is no peritoneal sac present to characterize them as true hernias. An enterocele, however, is a true hernia. (Fig. 1.) It may be either anterior or posterior in situation, depending on its relation to the uterus. Anterior enteroceles are rare; when they occur, there is a sac of peritoneum descending along the anterior vaginal wall between the vaginal wall and the bladder. I have never seen one. Posterior enteroceles are relatively uncommon, but they occur much more frequently than most physicians and surgeons suppose. Many of the supposedly recurrent rectoceles are in reality posterior enteroceles, and on careful dissection, a peritoneal sac can be demonstrated descending between the rectal wall and the posterior wall of the vagina. Since 1925, when the condition of posterior enterocele was first recognized as a surgical entity at The Mayo Clinic, we have seen eighty-eight cases. Anterior enteroceles can be diagnosed by vaginal examination, using a sound in the bladder; posterior enteroceles are easily recognized by making a combined vaginal and rectal examination.

In the beginning, I mentioned that intra-abdominal pressure as well as lacerations of the muscular and fascial planes was a causative factor in producing gynecologic hernia. There is no doubt that the development of all types of gynecologic hernias, in common with the development of abdominal hernias, is hastened by anything that increases pressure from within the abdomen, such as obesity, tendency toward constipation, intra-abdominal tumors, coughing, sneezing, straining at stool or at heavy work, and simply the patient's being in the erect position for long periods of time.

Uterine Prolapse. Many women have uterine prolapse to a greater or lesser degree, but attend to their usual household and social duties with little or no complaint. Others experience definite symptoms arising from relatively slight anatomic changes. As a rule, uterine prolapse is accompanied by cystocele of some degree, and it is the

symptoms produced by the protruding bladder when it is incompletely emptied, and the resulting infection, that first bring the normally strong levator ani muscles contract and provide definite support for the anterior vaginal wall in compensation

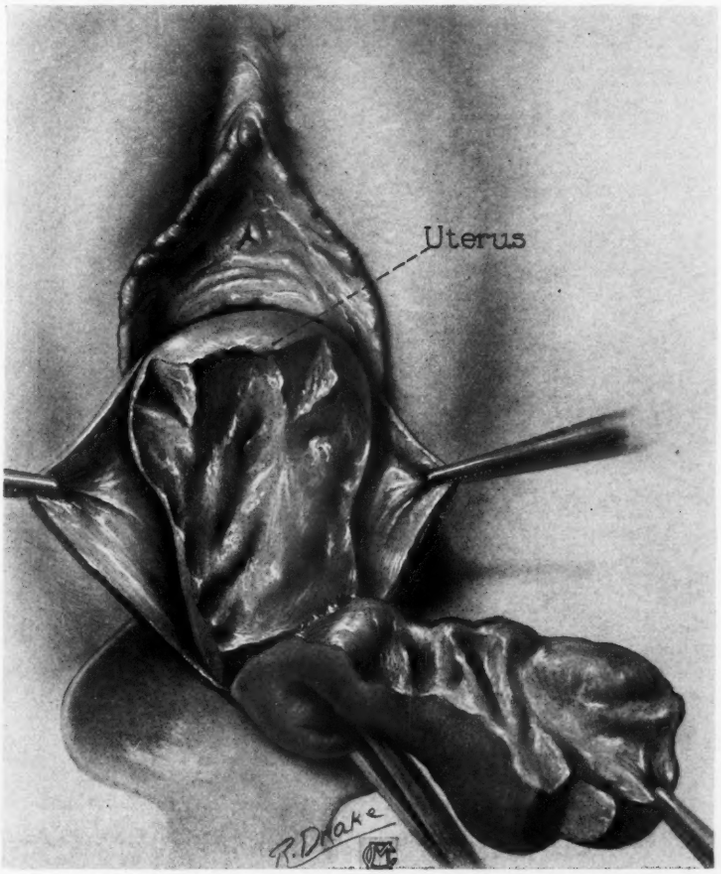

Fig. 2. Modification of the Watkins-Wertheim operation for prolapsus uteri and cystocele, with removal of considerable portion of the uterus, including all the endometrium and cervix.

these patients to the gynecologists. In the presence of an extreme degree of cystocele, hydroureterosis occasionally results, as well as hydronephrosis caused by distortion of the base of the bladder, and ureteral obstruction as the result of traction at the vesical end of the ureters. In evaluating disorders of the urinary tract, the physician must ever keep in mind the possibility of a neurologic cause, and realize that in such cases, gynecologic surgery is not indicated.

Rectoceles. Grade 1 rectoceles are common in women who have had multiple deliveries. As a rule, these rectoceles produce little trouble, but the gynecologist must ever keep in mind the fact that the normal vagina is a closed canal, and that in the occurrence of strain from any cause, for the increased pressure from above, thus protecting against the development of cystocele and uterine prolapse. But if the levator ani muscles are torn or if the perineal body is disrupted, this support for the uterus and bladder is lost, and a vicious tendency toward the production of anatomic changes is present. Furthermore, as a rectocele gradually increases in size, a definite pouch develops in the anterior rectal wall; this pouch protrudes through the vaginal introitus and bulges over the internal sphincter ani. This interferes markedly with emptying of the bowel and patients having this condition soon find that it is necessary to depress the posterior vaginal wall before a bowel movement is possible.

Enteroceles. Enteroceles, or true vaginal hernias, result from lacerations of the supporting fascia, either in front or behind the uterus just below the level of the peritoneal reflection. Most of the patients having enterocele that I have seen have had previous perineorrhaphies performed, a fact which makes it impossible to say whether the injuries predisposing to the condition were the result of lacerations at the time of childbirth, and that the peritoneal sac was not recognized at the time perineorrhaphy was done, or that the condition developed subsequent to the perineorrhaphy as the result of making an opening into the cul-de-sac of Douglas, or at least up to the peritoneum, with inadequate closure at that time.

Palliative Treatment. Surgical repair is indicated in most cases of extensive vaginal herniation. Many women, however, who do not have marked symptoms and are contemplating the birth of more children, prefer to delay surgical intervention even at the risk of undergoing a more radical operation at a later date. In the case of some debilitated, elderly women, there is a definite contraindication to surgical intervention of any type.

If surgical intervention is not indicated or if it is refused by the patient, the advisability of using nonsurgical measures, such as the insertion of tampons and pessaries, must be considered. Tampons are often the most satisfactory means of retaining a prolapsed uterus with associated cystocele and rectocele in elderly women. The use of some type of pessary often gives definite relief to women who are suffering from cystocele, uterine prolapse and high rectoceles. If the perineum has been extensively lacerated, however, it is usually difficult to fit a pessary so that it will be comfortable for the patient, and yet remain in place.

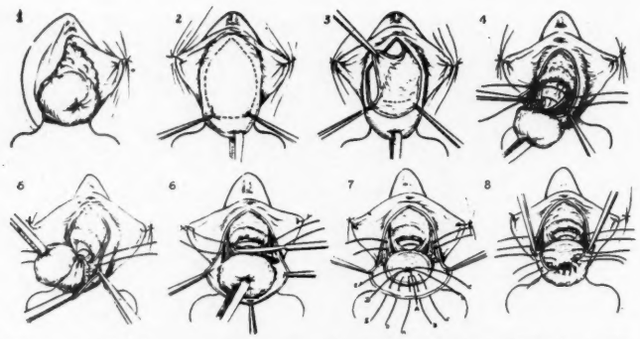

FIG. 3. Various stages in the Manchester (Fothergill) operation for prolapsus uteri and cystocele.

No one type of pessary is satisfactory in all cases. The ones most useful probably are the simple ball type, the doughnut type, the Menge, the Gehrung and the Gellhorn types. They all tend to produce leucorrhea, and unless the patient can remove and re-insert them herself, they are not practical. Allowing them to remain in place over long periods tends to cause irritation and ulceration. Daily douches are always advisable when pessaries are being worn and patients must recognize the fact that the wearing of a pessary does not cure the condition. It simply prevents further tendency to procidentia.

SURGICAL TREATMENT

Indications. The type of operation indicated varies with the extent of the herniation, and the personal experience and judgment of the surgeon; also, with the age of the patient and her marital state. The relative dangers of an abdominal or vaginal operation, and the severity of the symptoms must be carefully considered in each case. Any routine type of operation must be condemned, because it certainly would be too radical in many cases and insufficient in others. In some cases in

which a slight urinary incontinence is caused by minor laceration of the vesical sphincter and is possibly accompanied by

causative factor in the production of gynecologic hernias is a lacerated levator ani muscle, and that a perineorrhaphy is

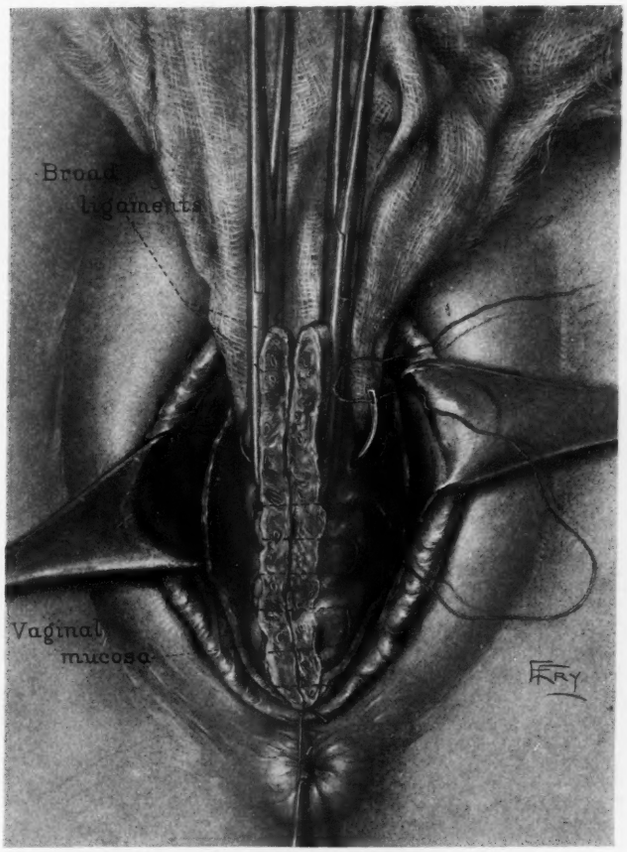

Fig. 4. The Mayo operation for prolapsus uteri and cystocele. Uterus removed. Broad ligaments approximated. Later, the broad ligaments are interposed beneath the bladder in the same manner as the uterus is in an interposition operation.

a small urethrocele, a few well placed sutures after an adequate freeing of the anterior vaginal mucous membrane is all that is necessary to obtain a good result. In case of the presence of a definite cystocele, a more radical operation is indicated, because almost all such cystoceles tend to protrude more and more as time passes. In many instances, simply freeing the bladder, fixing it at a higher level on the anterior uterine wall; a more or less extensive reconstruction of the muscles and fasciae in the anterior vaginal wall; and removal of an elliptical piece of the stretched-out vaginal mucous membrane, will produce good results. But it must be borne in mind that an important

an essential reparative procedure in all cases. If the retrodisplacement of the uterus also exists, some type of internal shortening of the round ligaments or fixation of the uterus, should be done at the same time.

Interposition Operation for Cystocele. In many cases of grade 2 or 3 cystocele, in which there is uterine prolapse of no more extent than grade 2, the interposition operation (Watkins-Wertheim) plus a perineorrhaphy produces good results. (Fig. 2.) If the patient is still in the childbearing age and the aforementioned operation is decided upon, the Fallopian tubes should be sectioned and the proximal end of the Fallopian tubes kept outside the peritoneal

cavity by stitching the cut edge of the peritoneum well below the uterine fundus on the posterior uterine wall. In many cases, and especially before the menopause, the uterus is too large to permit the regular technique, but this difficulty can be overcome by cutting away a portion of it. In some cases, I have removed more than half of the organ, including all the anterior uterine wall and the interstitial part of the Fallopian tubes, all the endometrium and all the cervix. I then stitched what was left of the uterus into a pear-shaped mass, and interposed it as a living pessary under the bladder, firmly fixing it into the anterior vaginal wall with interrupted sutures.

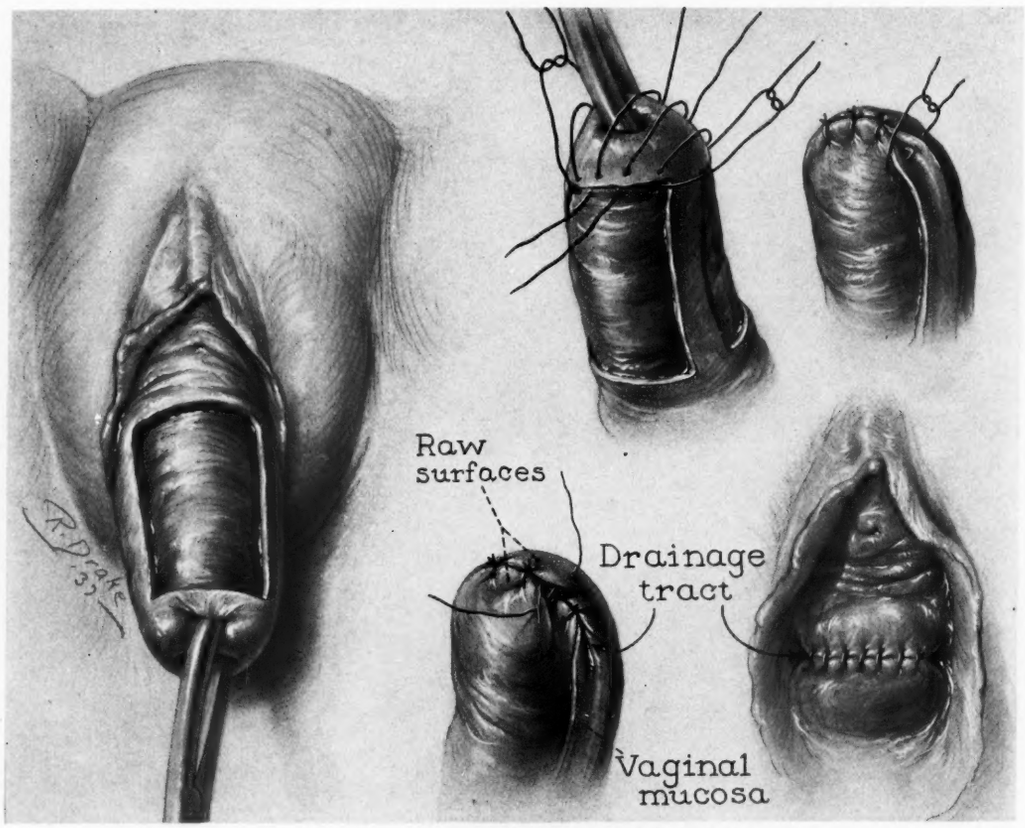

FIG. 5. Various stages of the LeFort partial vaginectomy.

Manchester (Fothergill) Operation for Uterine Prolapse. In other cases, particularly when future childbearing is contemplated, the Manchester type of operation (as described by Fothergill) can be done. (Fig. 3.) This operation usually requires that the cervix be amputated and the bladder freed from the cervix and fixed at a higher level on the uterine wall. The cardinal ligaments are then stitched across the anterior surface of the uterus at about the level of the internal os, thus forcing the cervix toward the os sacrum. The musculofascial tissues in the anterior vaginal wall are then brought to the midline, and after removing the excess of mucous membrane, the cut edges of the anterior vaginal wall are also closed with enough tension to obliterate all dead space. A perineorrhaphy is essential in all cases.

Mayo Vaginal Hysterectomy for Cystocele and Prolapse. If the uterine prolapse is grade 3 or 4, the Mayo type of vaginal hysterectomy for correction of cystocele and uterine prolapse is satisfactory. (Fig. 4.) In performing this operation, the uterus is removed through the vagina, the cul-de-sac of Douglas is partially obliterated, and the broad ligaments of the uterus are approximated in the midline. The approximated broad ligaments are then sutured

under the bladder, functioning as a support for that structure; the broad ligaments are also sutured into the anterior vaginal wall as the uterine body is sutured in place in an interposition operation. In cases of marked prolapse, this operation is indicated for only elderly patients, because there is usually some shortening of the vagina after the procedure has been completed.

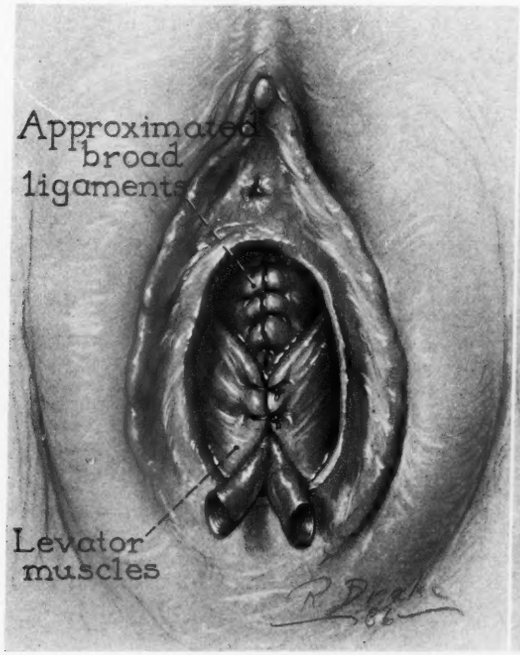

Fig. 6. Vaginal hysterectomy followed by colpectomy. The approximated levator ani muscles are stitched to the lower edge of the approximated broad ligaments.

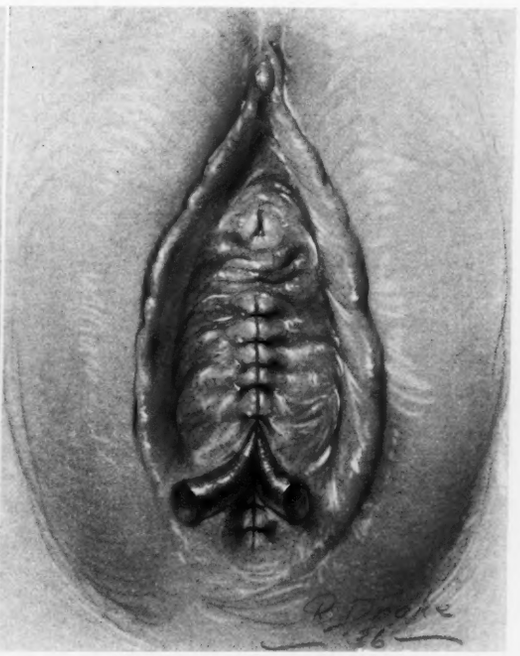

Fig. 7. Colpectomy completed by closure of the cut edges of the mucous membrane.

Partial and Complete Colpectomy. It is not at all uncommon to encounter marked prolapse of the vault of the vagina accompanied by a cystocele and rectocele following a previous hysterectomy. These are always difficult cases to repair adequately and yet retain a satisfactory vaginal canal. If the patient is elderly, there is no objection to performing a complete colpectomy. In the case of younger women, it is advisable, after performing a plastic operation on both the anterior and posterior vaginal walls, to open the abdomen and to reconstruct, as much as possible, the normal support for the vaginal vault or the uterine cervix. In some cases, the use of living sutures taken from the fasciae latae will be essential to give the necessary support. Powell suggests the use of a strip of fascia taken from the rectus abdominalis muscle, leaving it attached at its lower end.

In some cases of marked prolapse of the uterus in elderly women, it is advisable to do the LeFort type of partial vaginectomy; but I believe that in cases in which any such operation is indicated, it is better first to perform a vaginal hysterectomy and then a complete vaginectomy. (Figs. 5, 6 and 7.) This procedure is no longer than, and is as safe as, others.

Fixation and Shortening Operations. In occasional cases, a plastic operation on the anterior and posterior vaginal walls, followed by a shortening of the round ligaments of the uterus or by some type of fixation of the uterine fundus in the anterior abdominal wall, are both satisfactory procedures; but no method of shortening the round ligaments or fixation of the uterine fundus in the anterior abdominal wall is in itself a cure for cystocele in the case of a patient who is required to be on her feet for long periods. It does produce marked relief and an apparent cure of the

cystocele for a short time, but sooner or later an elongated cervix and a large cystocele will appear at the vulva as the result of stretching of the weakened anterior vaginal wall. In several cases following performance of a Kocher or Murphy type of operation, I have seen the cervix protrude through the introitus vaginae, accompanied by a large cystocele, and yet the fundus in these cases remained attached to the recti muscles.

In many cases of marked prolapse of the uterus and cystocele, there is apparently little or no rectocele because the increased intraabdominal pressure causes the cervix to impinge on the posterior vaginal wall, holding it back in much the same manner as a pessary would. In such a case, if any operation is performed that is simply designed to hold the uterus and bladder up, the patient will in a very short time notice the development of a marked bulging of the posterior vaginal wall, a bulging she had not experienced before.

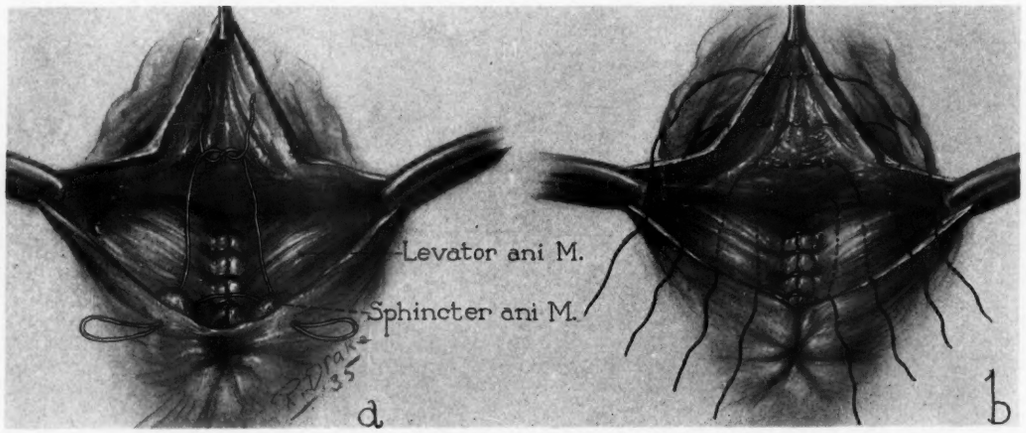

FIG. 8. a, the slip stitch used in the repair of sphincter ani muscle. b, the ordinary type of repair of lacerated perineum with approximation of the levator ani muscles in the midline and insertion of a series of crown sutures, the tying of which changes the axis of the vagina and reconstructs a perineal body.

INJURIES TO THE PERINEUM

All types of gynecologic hernias are more or less dependent upon injuries to the perineum. The injuries are of two types: (1) tears of the vaginal sulcus which involve the levator ani muscles and the deep pelvic fascia on either side of the posterior vaginal wall; and (2) those occurring in the midline through the perineal body. Both types of tears interfere with the normal closing of the vagina and the normal support which the levator ani muscles ordinarily give to the anterior vaginal wall when intraabdominal pressure is increased.

Surgical Treatment. Sulcus, or lateral, tears are more common in occurrence than midline perineal tears, and as a rule they can be satisfactorily repaired immediately after childbirth. If this repair is not done, and a rectocele develops, it will be necessary thoroughly to separate the protruding bowel from the vaginal wall and to anchor it at a higher level to normal tissues. The excess of vaginal mucous membrane should then be removed and a new perineal body should be constructed, using the approximated levator ani muscles as a base. By so doing, the normal axis of the vagina is restored. This operation (Fig. 8) is not an anatomic repair at the site of the laceration, but it offers good mechanical and physiologic results.

Midline tears of the perineum may involve only the perineal body with a resulting relaxation of the levator ani muscles. In such cases, primary repair, or a late repair similar to that used for vaginal sulcus tears, is satisfactory. If the tear is a little more extensive, the sphincter ani muscles will be injured and in extreme

cases the tear may extend into the anal canal. Primary repair of such tears is not satisfactory. As a rule, it is advisable to wait about five months to allow all raw surfaces to become completely epithelized and to permit the underlying tissues to develop a good blood supply and to become free from infection. The most important consideration in the surgical treatment of complete tears is to obtain a competent anal sphincter muscle by means of a plastic operation on both the anterior anal wall and the sphincter ani muscle. Following this procedure, a repair of the perineum similar to the type used in less extensive tears should be done, utilizing the levator ani muscles to hold the rectum back. Reconstruction of a new perineal body to correct the vaginal axis is essential to a good result.

CONCLUSIONS

1. The tendency to procidentia uteri can be overcome in most instances by satisfactory repair of lacerations at the time of childbirth or soon afterward.

2. Nonoperative measures, such as the use of tampons and pessaries, have a limited field of usefulness.

3. It is important to realize that the condition under treatment is a hernia, and that the larger the hernial opening, the more difficult will be the closure of it.

4. The type of operation to be performed should be carefully selected in each case, and the surgeon should keep in mind the extent of the prolapse, the size of the associated cystocele and rectocele, the age of the patient, her marital state, and the relative dangers of an abdominal or vaginal operation.

5. An enterocele, or true vaginal hernia, is occasionally present in association with or without other types of gynecologic hernia.

6. In difficult or recurrent cases of marked gynecologic hernia in elderly patients, it is sometimes advisable partially or completely to obliterate the vaginal canal.

7. A perineorrhaphy is an essential part of the operative repair of all gynecologic hernias.

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UTEROTUBAL INSUFFLATION WITH SPECIAL REFERENCE TO TECHNIC

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DURING the past twenty years since the inception of this nonoperative test for tubal patency many modifications of the procedure have been reported. In the beginning oxygen was used. The amount of oxygen was measured roughly by counting per minute the number of bubbles that passed through a wash bottle. A Baumanometer was attached to measure the pressure produced by the gas passing into the uterus and through the fallopian tubes.

From the outset an attempt was made to control the two physical factors involved in tubal insufflation, namely, volume and pressure. These factors were considered next in importance to definite clinical indications and contraindications which had to be laid down in order to safeguard the patient against untoward sequellae and possible risk. No modification of the method which does not provide these essentials can be considered adequate.

The idea basic to the new method appeared at first so simple that many lost sight of the elements essential for safety. Thus air was soon adopted in simplified technics. The objection to the use of air became clearer as experience with it in large and small series of cases accumulated. It was soon appreciated that air had the inherent element of danger of producing embolism, while the shoulder pains due to its persistence lasted from one to several days, depending upon the quantity which was insufflated.

Simplified methods with air occasionally adopted as the medium for insufflation using rubber bulbs and syringes of varying types and capacities were resorted to during the early period of development of the test. Bearing in mind the essentials for a safe and scientific procedure, the necessity of assembling an apparatus which combined elements of precision was met gradually.

The use of oxygen from the start was aided by a rough measuring device and a manometer. Two changes were made in this respect: First, carbon dioxide was substituted for oxygen because the former was theoretically more rapidly resorbable and less prone to produce embolism while reducing or eliminating persistent shoulder pains. The second was to employ a volumeter of fixed capacity. For this purpose the siphon meter, as employed in the chlorinating of water, was adopted. Pressure in the carbon dioxide tank was further regulated by a reducing valve to one atmosphere or a fraction which was found useful in providing a constant pressure rate flow.

The delivery of carbon dioxide in a constant rate flow was considered important. First, it produced less violent reaction on the part of the uterus and tubes; secondly, it served as a means of comparison of the reactions between patient and patient, and particularly when it was deemed advisable to repeat the test in the same patient for diagnostic or therapeutic purposes at stated intervals. A constant, uniform rate flow is unattainable by the hand when employing bulb or syringe. (Fig. 1.)

After experience with the first several hundred insufflations, it became clear that the recording of the pressure variations previously observed by watching fluctuations in the manometer might prove of interest and perhaps of value. In 1925 a kymograph was added to the insufflation apparatus employing carbon paper at first and soon thereafter an ink recorder. (Fig. 2.)

The data derived from this completed insufflation apparatus since 1925 and 1926 have proved to be increasingly valuable.

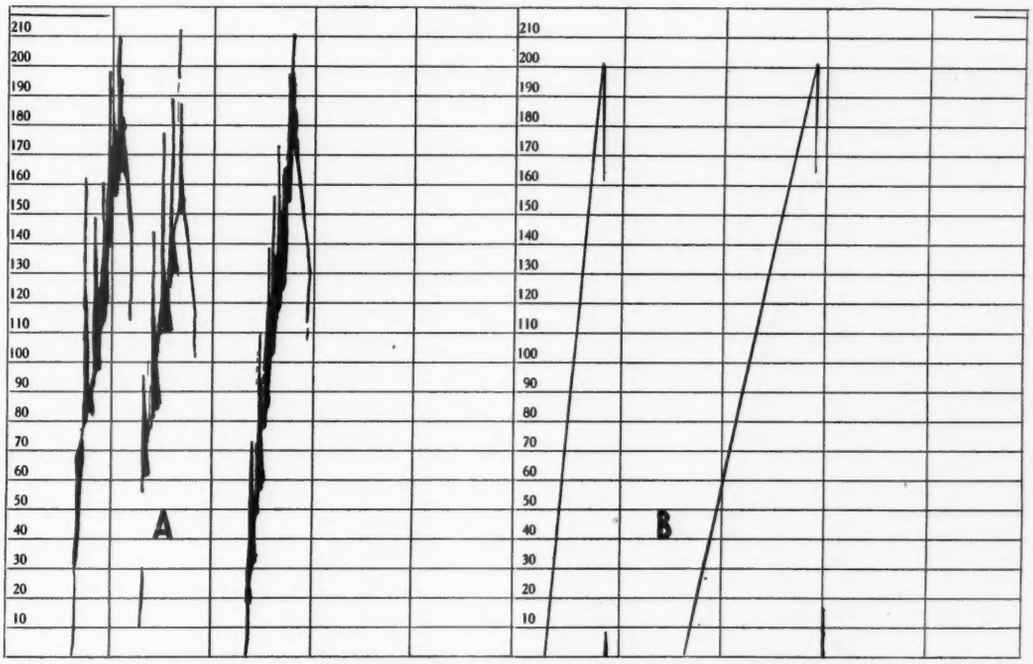

FIG. 1. Note difference in kymographic record between *A*, obtained by using hand pressure on rubber bulb, and *B*, constant rate flow obtained by reduction valve and siphon meter.

At first the graphs obtained of individual insufflations served as permanent records for the patient's gynecologic history. Later they indicated that not only was tubal patency distinguishable from nonpatency but such variations were obtained that when grouped into certain patterns, they appeared to be characteristic of permeable tubal strictures, peritubal adhesions and uterotubal spasm.

The correct interpretation of these graphs required checking by laparotomy observations, by controlled examination with radiopaque substances (hysterosalpingography) and by experimental reproduction of the pathologic conditions underlying the pattern changes. The experiments were made upon inanimate devices and upon living and dead organs. In a number of instances the extirpated uterus and tubes which were removed for various gynecologic conditions were kept in the surviving state for several hours and subjected to insufflation. Rhythmic contractions were manifested when the fallopian tubes were normal as in cases associating fibromyomas and they were completely absent when the tubes were nonpatent. In the presence of adhesions and distortion of the tubes there were apt to be atypical contractions.

The dead organs exhibited no rhythmic contractions and permitted the gas to pass through the tubes under varying primary pressures without undergoing rhythmic oscillations. The oviducts of sows, of monkeys and of rabbits also subjected to experimental insufflation exhibited similar rhythmic contractions under normal circumstances or none when they were dead or nonpatent. The living intact oviducts of monkeys and rabbits manifest rhythmic pressure changes closely resembling the rhythmic contractions which are obtained in clinical tubal insufflation.

These manifestations of function of the fallopian tubes cannot be demonstrated when air is employed as in the simplified methods nor when carbon dioxide is used instead of air, without a constant uniform pressure rate flow. Though I have advised the use of carbon dioxide instead of air injected by the hand syringe in order to

avoid the persistent shoulder pains and also the poss bility of air embolism, it was with the knowledge that the results would be incomplete.

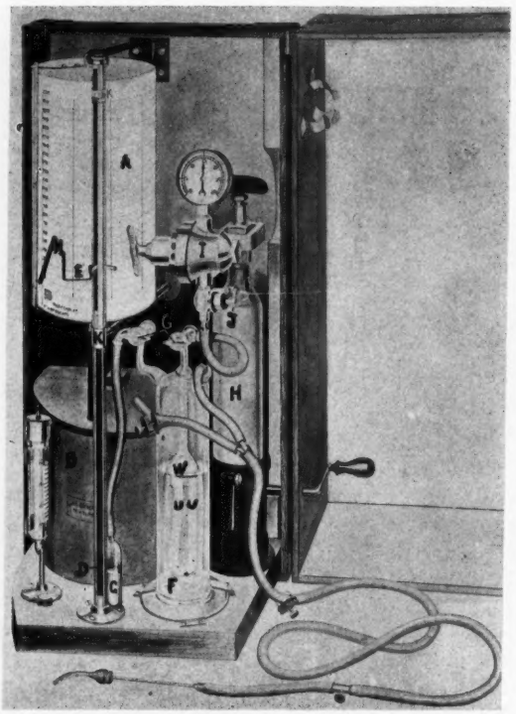

Fig. 2. Kymographic insufflation apparatus with ink recorder.

Comparative study of the graphic records during the past fifteen years has brought out data that are now considered invaluable. The method of kymographic uterotubal insufflation has in recent years been employed as a method of biodynamic assay of hormones and of pharmacodynamic assay of oxytocics and other substances used in gynecology and obstetrics. This special application obviously interests research workers but its chief sphere of usefulness is in the clinical investigation of female sterility and infertility.

Before entering into a description of the technic it is necessary to appreciate what the test is designed for and under what circumstances it is safe to apply the procedure. For these reasons the indications are the following:

Specifically, uterotubal insufflation is designed to diagnose the fact of patency or nonpatency of the uterotubal tract in cases of sterility. Kymographic insufflation establishes the particular functional state of the fallopian tubes.

The contraindications are: (1) pelvic inflammation (acute or subacute); (2) presence of genital bleeding; (3) presence of pregnancy; (4) pelvic tenderness without other evidence of pelvic inflammation.

An indispensable precaution in each case is to make a careful, thorough bimanual examination including specular inspection of the cervix and vagina. The presence of pelvic tenderness and of profuse secretions despite their nongonococcal character should contraindicate insufflation. The latter can be deferred until these unfavorable conditions are corrected by appropriate treatment.

The aseptic procedure involves removal of simple, vaginal and cervical secretions by aspiration and sponges and of painting the external os and the vaginal portion with tincture of iodine, mercurochrome, merthiolate or metaphen. The use of suction under twenty pounds of pressure removes cervical secretions (simple water suction is also useful as is suction from a bulb syringe). The most favorable time for insufflation is a few days after a regular menstrual period.

TECHNIC

The patient is in the lithotomy position. The uterine cannula is gently passed up into the uterine cavity to a point just above the internal os while the acorn expansion (rubber or metal) engages the external os of the cervix. (Fig. 3.) If the uterus is retroverted, an attempt should be made to bring it forward. When we are dealing with cases of sterility, it is advisable, in any event, to restore the uterus to the anterior position. If this is not feasible, the uterine cannula should be gently passed into the uterus in the backward direction. (Fig. 4.) In either case there should be no trauma. Grasping the anterior or posterior cervical lip with a volsellum is not necessary as a rule and may be reserved for instances where a

cervical stricture impedes the introduction of the cannula. In the latter exigency a suitable smaller cannula may be employed

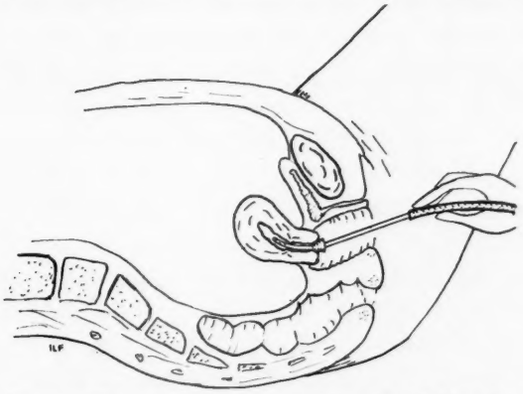

Fig. 3. The uterine cannula inserted within the uterine cavity, the acorn extension engaging the external os of the cervix. The tip of the uterine cannula is well within the uterine cavity. Uterus in normal anteverted position.

or measures instituted to dilate the cervical canal. It is always best under such circumstances to defer insufflation for a future time when it can be done without trauma.

The carbon dioxide gas under a primary pressure of fifteen pounds and regulated to flow at a rate of 60 cc. per minute is allowed to escape through the needle valve for a few seconds until the uterus accustoms itself to the cannula. (Fig. 3.) The valve is shut as the pulsation of the siphon takes place thus starting with zero pressure and zero quantity. When the tubes are patent the pressure rises at once to different levels below 100 mm. Hg as a rule and drops sharply 10:20:30 and 40 mm. Hg below its initial height, rising again and oscillating for as long as the insufflation is continued, one, two or three minutes.

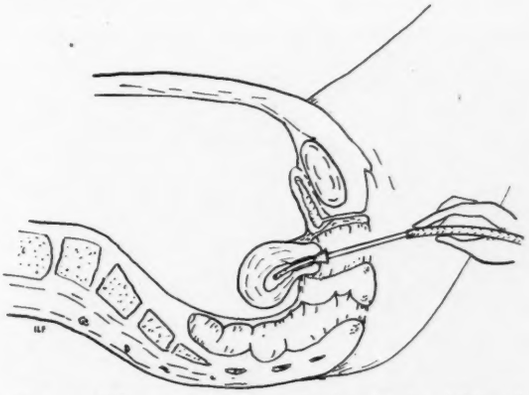

Fig. 4. The uterine cannula inserted within the uterine cavity, the acorn extension engaging the external os of the cervix. Uterus in retroverted position.

If the pressure continues to rise above 100 mm. Hg, it is due to obstruction which may be caused by spasm or by organic stricture or occlusion. In case of the last condition the pressure rises to the maximum level of 200 mm. Hg at which point it is maintained for a few seconds after the carbon dioxide flow has been stopped. The cannula is allowed to remain in the uterine cavity during this brief interval. If the pressure drops slightly or more markedly while the cannula is held firmly in the cervix and there is no regurgitation (the gas circuit being air-tight), the decline in pressure is very likely due to a slight escape through a strictured but partially patent tube or tubes. Repeating the insufflation immediately or at another

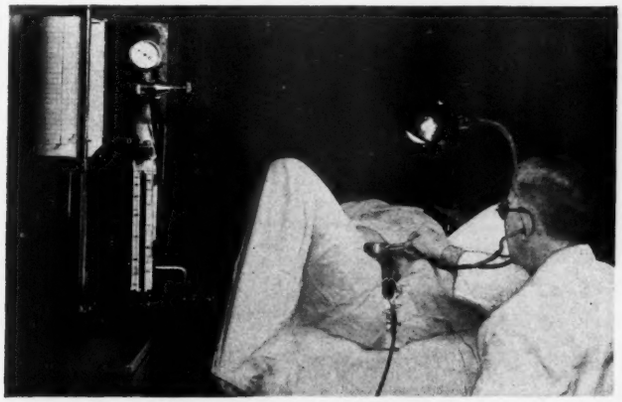

Fig. 5. Weighted stethoscope.

time may demonstrate that the carbon dioxide has succeeded in traversing a minute opening in one or both tubes.

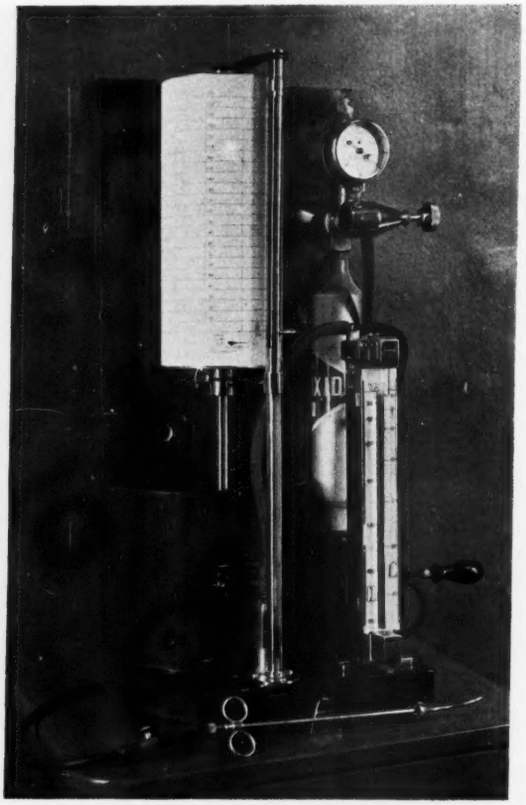

Fig. 6. Showing newer type of flow meter (Foregger type).

If after exceeding 100 mm. Hg the pressure suddenly drops to levels much lower and rises and falls in rhythmic fashion, it is evident that the uterotubal junctions were in a condition of spasm.

If the pressure rises to levels below 100 mm. Hg and is maintained at more or less the same level without exhibiting oscillations at all or feeble recording, i.e., shallow fluctuations, the tubes may be said to be held down by peritubal adhesions or dislocated by fibroids as the case may be. The relatively low pressure levels associated with shallow oscillations or their complete absence indicate that the tubal caliber is not affected but that its muscle function is impaired. A similar manifestation characterizes a depressed hormonal status, such as obtains in prolonged primary or secondary amenorrhea and the menopause. The clinical history will differentiate between this hypohormonal state and nonconstricting peritubal adhesions.

After the graph has been obtained, which requires one to three minutes in most cases, the cannula is withdrawn. Note is taken whether gas regurgitates from the cervix and to what extent. In cases requiring higher pressures there may be prolonged cervical regurgitation after the cannula is removed, which indicates that the carbon dioxide has been retained under pressure within the uterine cavity and in one or both tubes. This does not as a rule take place to any appreciable extent when the tubes are normal.

During the insufflation, attention to the presence of pelvic pain helps to localize the site of obstruction, if any be present. In normal tubal patency there is slight discomfort during the test in the suprasymphyseal area which disappears at once as soon as the cannula is removed. In the presence of bilateral uterotubal spasm this discomfort is increased. The same symptom is present when we are dealing with bilateral obstruction at the uterotubal junctions. If tubal obstruction is encountered beyond the uterine end, pain will be present lateral to the midline and depending upon whether it is present on one or both sides, its distribution will be unilateral or bilateral. The nearer the obstruction is located to the fimbria, the farther out will the pain in the pelvis radiate. The same reactions are met in permeable strictures.

Abdominal auscultation offers another aid in identifying open or closed tubes. Any stethoscope can be used for this purpose especially if the auscultation is left to an assistant. Without such help one can resort to any of the head stethoscopes or the conveniently weighted one devised by Leff. (Fig. 5.) The carbon dioxide passing through the fimbriated end produces a whistling, purring sound. If, for example, the right tube is open and the left tube closed, the tubal souffle will be heard in the right lower abdominal quadrant and vice versa, if the left tube is

open and the right tube closed the bruit is heard on the left side.

Bilateral patency permits of an audible souffle in both lower abdominal quadrants. Without going into refinement of sound production and its musical interpretation, it is important to note that the tubal souffle in normal tubes is intermittent and rhythmic corresponding to physiologic contractions and relaxations. In strictured tubes with partial patency the sound produced is constant, if at all audible, and lacks rhythmic recurrence because the tubal muscle under these circumstances is pathologically altered.

At the completion of the test, the cervix is wiped clean of the slight bloody ooze that may be present and a vaginal tampon is inserted to be worn for a few hours. As soon as the speculum is removed, the patient is allowed to sit up and is instructed to take a few deep breaths. This usually gives time for the carbon dioxide to rise to the diaphragm where it produces a subphrenic pneumoperitoneum of varying depth. The presence of carbon dioxide gas below the diaphragm produces pain in one or both shoulders and occasionally in the epigastrium.

The patient may be fluoroscoped immediately when the subphrenic pneumoperitoneum becomes visualized corresponding, as a rule, to the shoulder where the pain is localized. The fluoroscopic examination is corroborative. It is not absolutely essential in normal cases because the tubograph and shoulder symptoms are pathognomonic and it can be dispensed with in cases of nonpatency. But in the presence of high grade permeable strictures or when dealing with highly nervous patients whose subjective reactions cannot be relied upon, the fluoroscope can render important diagnostic aid.

The carbon dioxide may not rise to the diaphragm if (1) the quantity insufflated is too little, i.e., under 50 cc., (2) if the tubal strictures are tight requiring high pressures to circumvent so that only the least amount of carbon dioxide passes into the pelvis which may become absorbed while the patient is lying in the recumbent position and hence not reach the diaphragm, (3) if pelvic adhesions offer a barrier, and (4) if adhesions exist between the diaphragm and the superior surface of the liver which prevent the formation of a subphrenic pneumoperitoneum. This is not infrequent in old gonococcal infections in which the clinical history records the presence of upper abdominal and shoulder pains associated with the pelvic attack, which has resulted in the violin-string adhesions between liver and diaphragm described by A. H. Curtis.

The location of the shoulder pain is not diagnostic of the patency of the corresponding fallopian tube as carbon dioxide passing through the right patent tube may produce pain in the left shoulder while the gas escaping into the peritoneal cavity from the left patent tube may produce pain in the opposite shoulder. Both tubes may be freely patent and only a left-sided subphrenic pneumoperitoneum or a right-sided pneumoperitoneum be produced. Much depends upon the position of the colon, the distribution of the intestinal coils and upon the weight and mobility of the liver and stomach.

The pains in the right shoulder are more common than in the left shoulder because the stretching of the falciform ligament produces a more definite irritation of the right phrenic nerve. On the left side because apparently of the greater range of mobility of the stomach, pain in the left shoulder is not uniformly produced. It requires a deeper left subphrenic pneumoperitoneum to cause phrenic irritation than a right-sided subphrenic pneumoperitoneum. In making the fluoroscopic examination, the subphrenic space under the right diaphragm is always clearer and unmistakable, while that on the left side should be differentiated from the stomach gas which is practically always present. In the latter case, the simple device of placing the patient on her left side and applying pressure over the right costal areas allows

the carbon dioxide to rise to the right subphrenic space where it is easily recognized. The patient notices the change by shifting of the pain from the left shoulder altogether to the right shoulder or by a marked lessening of the pain which may persist momentarily in the left shoulder. Fluoroscopically, the complete displacement or a marked reduction of the left subphrenic pneumoperitoneum can be noted.

The fluoroscopic examination requires but a few seconds immediately following which the patient is placed upon the table in the Trendelenburg position. Gentle pressure over both costal areas helps to displace the carbon dioxide toward the pelvis where it is rapidly absorbed while the pains in the shoulder disappear at once. After five or ten minutes, depending upon the amount used in the insufflation, the patient, free of symptoms, is allowed to get up and go about. She is able to resume her ordinary duties as if she had undergone a simple cystoscopic examination.

If a repetition of the test is considered advisable, it may be done after several days or after a month, observing in each case the rules of technic including bimanual and speculum examination and aseptic precautions. The apparatus with a siphonmeter makes the possibility of repeating the insufflation under the same physical conditions.

In the last two years I have been able, thanks to Dr. Foregger, to add a quantimetric device which permits not only the quick adjustment of the rate of flow, i.e., 60 cc. per minute, but also to vary this rate of flow conveniently for experimental purposes to slower rate flows. (Fig. 6.) The remainder of the kymographic insufflation apparatus, including blow-off safety device, is the same. Although intended to be foolproof, a desideratum earnestly wished for, such devices for insufflation which fix the rate flow completely to an unalterable flow rate restrict its flexible use. Unfortunately, every device, no matter how perfect, is subject to mishandling in one form or another. In any event, some degree of latitude must of necessity be allowed the operator. The siphon meter has a device (Fig. 3) which regulates the rate flow to a constant and uniform delivery of carbon dioxide. By regulating the needle valve (Fig. 2), the operator can change the flow to any desired speed between 30 and 60 cc. per minute. In order to stop the carbon dioxide flow the glass stop cock, "G," is turned to vertical position after which the tank value is shut. The needle valve, "J," remains open to allow the flow of gas at the rate of 60 cc. per minute. All that is necessary for a new insufflation is to open the tank valve and to turn the stop cock, "G," to the horizontal position which insures the uniform gas flow of 60 cc. per minute as prearranged. In applying this procedure as in any other diagnostic procedures, failure to take physical, i.e., mechanical precautions or of observing clinical indications and contraindications, can lead to untoward accidents and sequellae.

SUMMARY

In the hands of many who have used tubal insufflation, and have observed the precautions, the method has been carried out routinely with safety. In the course of the past twenty years its scope has gradually broadened. Its present usefulness may be summarized as follows:

1. To determine the status of tubal patency or nonpatency.

2. Before deciding upon the advisability of a cervical and abdominal operation to relieve sterility.

3. As a postoperative measure to test and maintain the patency of the newly formed stoma.

4. To check the results of a tubal sterilization operation with due pressure precaution.

5. To determine secondary effects upon the tubes, following induced abortions,

uterine retrodisplacements, appendicitis, tubal pregnancy and myomectomy.

6. In studying the physiology of tubes, as in functional amenorrhea, during the menopause and following *x*-ray castration.

7. To determine the tubal status in suitable cases before prescribing contraceptive measures.

8. To produce a pneumoperitoneum as an aid in abdominal diagnosis.

9. In the treatment of dysmenorrhea.

10. As a therapeutic substitute for laparotomy to improve the status of adherent and strictured tubes.

11. As a clinical biodynamic assay of hormonal and oxytocic effects.

Sarcoma of the breast is not a common disease. . . . It originates in the connective tissue of the organ, being deeply placed in its substance, or perhaps more frequently developing in the outer and upper quadrant.
From—"Rose & Carless Manual of Surgery," Edited by William T. Coughlin (The Williams & Wilkins Company).

INJURIES TO THE PENIS, URETHRA, SCROTUM AND TESTICLE

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INJURIES TO THE PENIS

INJURIES to the penis are rare. They practically never occur in the flaccid organ. The injuries may be self inflicted or caused by a second party. Trauma also occurs in industrial accidents. Stutzin[1] and J. Steinberg[2] have reported interesting cases of self mutilation. Complete traumatic avulsion[3–6] of the skin has been met with. Other etiologic factors are: the use of firearms,[7–10] violent sexual intercourse,[11] the use of strong chemicals such as iodine,[12] and the hypersensitivity to epinephrine in local anesthesia,[13] producing gangrene.

Avulsion of the skin is treated by plastic surgery. Since no two cases are alike the ingenuity of the surgeon is taxed. Contusions are superficial and caused by trauma to the erect penis. Rupture of small subcutaneous vessels, due to the laxity of the skin, cause an extravasation of blood in the subcutaneous tissues. At times, this bleeding is marked and produces a disfiguration with edema. Following a cessation of bleeding, a purplish discoloration supervenes and at times extends to the scrotum. Treatment should proceed along conservative lines. Rest and cold compresses should be employed to check bleeding. When bleeding has been checked hot compresses are to be applied. Hematomas should be evacuated.

RUPTURE (FRACTURE) OF THE PENIS

This implies a tear of one or more sheaths of the corpora with marked bleeding. Subcutaneous rupture of the urethra is rarely seen in the penile portion; 92 per cent occur[14] in the perineum. Rupture is caused by different forms of trauma; such as, direct blows, sudden collision or the dropping of a window on the organ. I shall very briefly point out the highlights of the anatomic factors involved:

The main portion of the penis consists of three elastic bodies separated from each other by envelopes of strong tissue. The corpora cavernosa occupy the dorsal position and lie side by side. In the ventral groove formed by their opposition is the corpus spongiosum through which passes the urethra. The corpora cavernosa are invested by a dense, fibro-elastic sheath or tunica vaginalis which is tough. It consists of two layers, an outer longitudinal and an inner circular layer.

The corpus spongiosum, which is composed of erectile tissue in addition to a sheath enveloping the corpora cavernosa and spongiosum, is surrounded external to these by another sheath, which binds all these structures together and is known as Buck's fascia or fascia penis. The rounded extremities of the corpora cavernosa are completely invested by this covering and extend to the angle of the penis where it joins the suspensory ligament.

When rupture occurs, sudden pain associated with a crackling sound is felt at the site of injury. The penis soon swells and reaches an immense size due to the marked extravasation of blood. The penis bends toward the uninjured side. If the bleeding spreads symmetrically to the scrotum, we have a bilateral rupture of the corpora. If deflection occurs to the injured side, one corpora is generally ruptured. Rupture may be simple or compound. For proper treatment is is necessary to distinguish between the two. Bleeding from the meatus usually appears if the urethra is involved.

Treatment should include rest, elevation of the penis and cold compresses. If the effusion persists, incise, ligate and suture the sheath. Hematomas are drained. Later immobilization of the penis in a splint is instituted to prevent deformity. Prognosis

is to be guarded, as deformity of the penis is frequent and causes difficulty in sexual intercourse and psychic reactions.

STRANGULATIONS OF THE PENIS

Strangulation of the penis is produced by any form of constriction back of the glans. The etiologic factors are many: a tight rubber band to hold a dressing, a tight bandage following circumcision, rings and bushings.[15–19] Strangulation has been known to occur in children due to a stupid mother or maid, who has been known to ligate[20] the penis to prevent enuresis. Long hair has acted as a ligature.[21] The end result may be gangrene of the penis and urethra with permanent fistulas. Dislocation of the penis is exceedingly rare. It is caused by a force so mechanically applied that the penis leaves its "moorings" and becomes displaced into the scrotum, groin, perineum or abdomen. Treatment consists in reducing the dislocation and taking care of the complications.

INJURIES TO THE URETHRA

Injuries of the urethra are of great importance; as urinary obstruction, extravasation and fistulas occur. Urethral rupture is the commonest and most serious. External wounds of the urethra have been common during warfare[22,23,24] but uncommon during civil life. Intra-urethral injuries result from trauma caused by a ragged calculus, improper instrumentation, a few internal urethrotomies,[25] some transurethral resections, certain second-stage prostatectomies and by the introduction of foreign bodies such as pins.

Difficult instrumental deliveries during labor and the improper and wrong use of drugs[26,27] injected into the urethra have been a factor. External blows[28] and violent sexual intercourse[29] have also been a factor. In one of my cases, a young man during an onanistic spell introduced a needle into his urethra for a distance of six inches.

Rupture of the urethra is the commonest and most serious injury. The rupture may be longitudinal, transverse, complete or incomplete, extrapelvic or intrapelvic. No part of the urethra is immune. Rupture of the pendulous portion is the least affected and may be caused by a fall, external blows or violent sexual intercourse. Straddle falls invariably produce injury to the bulbous or bulbomembranous portion of the urethra. These injuries are the most serious. Rupture of the posterior urethra seldom occurs without a fracture of the pelvis.

Sex Incidence. Approximately 90 per cent occur in the male because of occupational activity. The male urethra is firmly fixed with its close relation to the pubic bone. In the female the urethra moves with the anterior vaginal wall, and is less firmly attached.

Since the extravasation of the urine and blood is completely controlled by the two layers of the triangular ligament and Colles's fascia, it is essential to review briefly the extravasation possibilities controlled by these structures, for these aid us in a correct diagnosis. The union of Colles's fascia with the deep layer of the triangular ligament forms a space termed the superficial or anterior perineal. This is only opened anteriorly where it communicates with the superficial and deep layers of the abdominal fascia. This space contains the bulb, spongy portion of urethra and distal end of the membranous urethra. Extravasation at these points cannot go upward because of the dense inferior layer of the triangular ligament nor can it go backward into the ischiorectal region, inasmuch as the deep layer of Colles's fascia fuses with the inferior layer of the triangular ligament. The extravasation cannot spread into the thighs for both Colles's fascia and inferior triangular ligament attach laterally to the pubo-ischi rami. Thus a rupture of the urethra at the bulb, spongy portion, or distal end of the urethra causes a tumefaction at the scrotum, perineum, penis and lower abdominal wall.

If the membranous urethra is involved, the extravasation occurs in the ischiorectal fossae, buttocks or thighs. Tears of the superior triangular ligament cause extrav-

asation in the space of Retzius. The extravasation is held forward by Denonvillier's fascia. The peritoneum is pushed up from the bladder with extravasation passing to the space of Retzius.

Diagnosis. A pendulous urethra, slight hemorrhage, pain and difficulty in urination are diagnostic. Infection and urinary extravasation may occur. With a pendulous urethra that has been ruptured intense pain following injury, tumefaction resulting from hemorrhage, urinary infiltration, marked hemorrhage, hematoma in perineum and extravasation of urine may all be present. Difficulty in urination begins at once. An edema of the posterior urethra follows and causes acute retention. Urinary extravasation generally does not begin at once because of spasm at bladder sphincter. This spasm is approximately overcome at the end of twenty-four hours by the overdistended bladder. In a membranous and prostatic urethra bleeding may be absent from the external meatus. Urinary extravasation is deep seated in the perivesical tissues and between prostate and rectum.

Treatment. The first thing to do is to treat the shock, and to divert the stream of urine. There is a difference of opinion regarding the treatment of intrapelvic or bulbous urethra. Bailey[30] cites twelve methods that have been used in locating the severed end of the urethra but all are time consuming. On the other hand Rutherford,[31] in 1904, stated, "that in the lithotomy position the severed urethral ends are a considerable distance apart, yet when the legs are extended the severed ends are in approximation."

The urethral membrane has great powers of regeneration in urethral injuries by virtue of rapid proliferation of its epithelium. This explains how a complete rupture, which has nothing more than a cystotomy, has had excellent functional results even though no attempt has been made to unite the severed ends. This point has been advocated by Foulds.[32]

First, attempt to divert the stream of urine with a soft rubber catheter and leave the catheter in place for a week. Do not try the passage of a catheter in ruptures of the posterior urethra or those complicated by a fracture of the pelvis, as this would be adding "insult" to injury. In these cases an immediate cystotomy is the method of choice.

Urethrotomy may be attempted, which is performed in three ways: (1) End-to-end anastomosis;[33] (2), a retention catheter with neither urethral or perineal closure;[34] (3) a resection of all bruised parts, mobilization of the proximal spongy portion sufficiently to permit a free end-to-end anastomosis of healthy portions of the urethra over a large catheter.

The following case on our service illustrates how proper judgment produces good results:

A boy, 14 years of age, fell from a roof on to a gate with spikes. He fell with legs adducted. Examination revealed a swollen scrotum, nontransparent to light and the perineum swollen and red.

At operation a complete rupture of the urethra was found at the bulb which was separated for two inches. A rubber catheter No. 14 was passed through the distal urethra and then treaded through the proximal urethra. The edges of the urethra were sutured with three No. 1 interrupted chromic sutures.

The patient was discharged after eighteen days with the wound completely healed and 100 per cent of urine passing through the urethra. The after treatment of all tears of the urethra is of the utmost importance.

Prognosis. The mortality is slight except those complicated with fracture of the pelvis, laceration of bladder and internal injuries.

INJURIES TO THE SCROTUM

The scrotum may be subjected to extensive injury without damage to the testicles, because the latter slips away. Bleeding at times is profuse and ligation is necessary. The skin of the scrotum has a tendency to inversion, hence it must be ligated carefully. Due to the laxity, elasticity and redundancy, injuries favor extreme edema,

distention, extravasation and discoloration. The scrotum has great power of regeneration following denudation.

Besides being submitted to external injuries, damage to the scrotum is met with in industrial accidents causing avulsion[35,36] of the skin. Injuries have been caused by the self injection of foreign bodies, such as paraffin,[37] and the sensitivity to epinephrine[38] in local anesthesia. Gangrene of the scrotum[39] following closed operation for hydrocele has been reported. Avulsion of the skin of the scrotum is treated by plastic surgery.

INJURIES TO THE TESTICLE

The testicle is usually traumatized by a direct blow, because of its mobility and position in the scrotum. Slight trauma is painful and produces various degrees of shock due to the pressure or irritation of the testicular nerves communicating by way of the spermatic plexus with the aortic and solar plexus. Various degrees of pathologic changes are noticed ranging from capillary hemorrhages to rupture of the tunica albuginea with a hemacele.

In many of these injuries atrophy ensues due to cicatrices. Atrophy is also produced following herniotomy as a result of the interference of the blood supply of the spermatic cord and following recurrent torsion of the cord. The Romans produced eunuchs by squeezing the testicles of infants between their fingers. This trauma induced atrophy. A repetition of the injury will cause malignancy.[40]

Treatment should consist of rest, elevation of scrotum, cold compresses at first and later hot compresses. If infection supervenes with pus formation, evacuation should be employed. If hemorrhage is severe, operative interference is necessary. Stab wounds heal readily if no infection is present. If the tunica albuginea has been cut, it should be sutured to prevent hernia of the testis.

Industrial lesions are rare. In a series of 100 cases Crane[41] found only three that were really attributed to an industrial accident. Injuries to the epididymis and testis are always associated. Orchitis is rare because of the firm support of the tunica albuginea. Close investment also accounts for the slower swelling. Epididymitis alone, except in the rare hemotogenous infections, is always secondary to infection of the prostate and seminal vesicles. To exclude malingering, a complete genito-urinary examination is necessary. The prostate and vesicles should always be examined. Epididymo-orchitis may be produced by a strain, i.e., pulling, lifting and straddling. This is probably caused by a violent contraction of the cremasteric muscle striking the pillars of the external abdominal ring.

Dislocation of the testicle is exceedingly rare and mostly congenital. There are three types: (1) internal, inguinal, abdominal or femoral; (2) external, subcutaneous inguinal, pubic, penile, perineal and crural. (3) rupture through the scrotum.

Treatment involves the replacement of the testicle manually; if unsuccessful, surgical intervention is necessary.

Torsion of the testicle is a twist of the spermatic cord, either to the right or to the left and may occur at any age. The etiologic factor is some congenital anomoly. The exciting cause is a muscular exertion as jumping or heavy lifting which causes a sudden contraction of the cremasteric muscle. Occasionally, the testicle is found to be the site of malignancy. The symptoms are the same as for epididymitis or orchi-epididymitis.

Diagnosis. There is usually a sudden onset, severe pain, high position of the testicle, local swelling and tenderness. Pain ceases following gangrene.

Treatment. An attempt should be made to rotate in the direction opposite to the pain. If unsuccessful, immediate surgical intervention is necessary. The testicle should be anchored to prevent recurrence.

CONCLUSION

Injuries of the penis, urethra, scrotum and testicle have been briefly considered. The causes are varied and some are un-

usual. The urologist must be on the alert, as no two cases are alike. At times his ingenuity will be taxed and after treatment is of the utmost importance.

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UNDESCENDED TESTICLE

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THE management of cryptorchidism in one's office of necessity confines itself to proper examination, diagnosis and classification of each individual case, plus the intelligent application of hormonal therapy.

The treatment of this interesting condition by gonadotropic agents is generally recognized notwithstanding the fact that reports are so varied that the average practitioner is somewhat confused and, at times, disappointed in their use. Many still question the value of organotherapy on the basis that a certain good percentage of ectopic testes will descend spontaneously of their own accord. Obviously, whether or not this occurs will depend upon the underlying etiologic factors, namely, mechanical obstruction to descent or dysfunction of the endocrine apparatus. The incidence of undescended testes is less after puberty than before that period, suggesting strongly that the hormonal changes incident to puberty produces spontaneous descent in a good percentage of cases. In the following paragraphs, it is proposed to discuss the nonsurgical treatment of this malformation.

It is beyond the scope of this paper to touch on the many underlying theoretic problems involved here, particularly the physiology of descent, still a controversial question, the pathologic anatomy or hormonal deficiencies. However, the fact is that in the human species it is normal for the testes to descend into the scrotum before or soon after birth and to remain there continuously. Successful descent provides the essential environment so necessary for spermatogenesis and the proper, full growth of the orchids. Retained testes beyond puberty are invariably sterile because the spermatogenic epithelium is damaged. Of great importance, too, is the tendency of the undescended testes to undergo atrophy and, in a certain definite percentage of cases, malignant degeneration may occur. Recent work has shown that there may be a deficiency in the endocrine function of the malpositioned organ. In addition to all this, and not the least important, is the psychic effect of the condition on the growing child. One then appreciates the importance of cryptorchidism and the need for our efforts to correct it properly.

Malposition of the testes is encountered in two types of boys: First, there are those who, aside from maldescent of one or both gonads, are normal. The second group includes boys who have signs of hypothyropituitarism or hypogenitalism as well as cryptorchidism. It is a fact that in the child with cryptorchidism and hypogenitalism, hormonal therapy is most effective. The clinical studies of Shapiro and Sexton, Spence and Scowen, etc., tend to bear out this statement. Especially is this true if the testicle is retractile, that is, not fixed in its abnormal position.

Treatment for undescended testes may be postponed until the boy is 10 or 11 years of age for the following reasons: First, as already stated, the testes may descend spontaneously before this time provided there is no barrier present. Second, there is no clinical or experimental evidence to prove that harm results to the gonads by reason of its retained position prior to natural puberty. Whether watchful waiting for spontaneous descent, surgical intervention or hormonal therapy is advisable, will depend largely upon the fixation of the testicle. Spence and Scowen have stated very definitely that, "the disadvantage of waiting for spontaneous descent in any except the retractile type is that if an anatomical abnormality is present, spontaneous descent can never occur. Waiting until after puberty in the hopes of spon-

taneous descent is in such cases an unnecessary and unjustifiable delay." Orchidopexy, in this instance, is clearly indicated before puberty has set in. Rea positively states that in his experience, spontaneous descent of a testis retained by mechanical factors never occurs, and he doubts the value of the use of hormonal therapy in these cases.

All patients when first seen should be subjected to a thorough physical examination, noting first the general appearance of the child, second, the degree of development of the genitals and third, the situation and mobility of the testes. Of importance, too, is the patient's age. After consideration of all the above factors, the following rules may be laid down: (1) In a preadolescent cryptorchid child, otherwise normal and in whom the testicle is retractile, it is good judgment to wait until he is 10 to 11 years of age before therapy is considered. If spontaneous descent has not occurred, hormonal therapy should be instituted for at least three months. If no positive results follow or if evidence of the onset of premature puberty should become manifest, operative intervention should be advised without delay. (2) If, in the same type of patient, the testicle is fixed in its malposition, one can conclude that an anatomic barrier to descent is present. Orchidopexy, in this instance, should be considered before puberty and preceded by hormonal therapy for one to two months. In this situation, organotherapy is indicated because of its growth promotional effects induced in the cord structures. We refer to the influence on the elongation and development of the spermatic cord and the pampiniform plexus. These effects are necessary precursors of successful plastic surgery. (3) If the patient has already attained puberty and whether the testicle is fixed or not, surgery should be advised without delay, preceded by endocrine therapy to facilitate the procedure. (4) Where evidence of other glandular deficiencies exist, supplemental treatment should be instituted for its correction.

The routine plan of hormonal administration that we consider adequate yet safe is to give 300 rat units of any of the reliable brands of gonadotropic agents twice a week for eight to ten weeks. If no positive response is noted after four to six weeks' rest, a second similar course of treatment is given. Treatment is discontinued when no effect is noted. It is generally considered that this amount of treatment is adequate to bring about a favorable result and that if descent has not occurred, it can reasonably be assumed, in most cases, that an anatomic barrier exists. Orchidopexy is advised without too much delay, because having induced in the testes tissue changes characteristic of puberty by administering hormones, degenerative changes and loss of spermatogenic function will surely occur if the gonads remain extrascrotal.

Male sex hormones (testosterone propionate) may be used to advantage in those cryptorchids with hypogenitalism. In our experience its growth promoting effect on the penis and testicles is, at times, quite definite. The plan usually followed is to administer two to three injections a week, 5 to 10 mg. each, for a period of four to six weeks. A total of 60 to 80 mg. constitute a course. After a rest interval of four to six weeks, a second course may be given.

Caution should be exercised against the employment of excessive quantities of endocrines. It has been shown recently by investigators, principally Eisenstaedt, Appel, Fraenkel and Rolnick, Lieberthal and Baker, that large doses are distinctly detrimental. At operation, these workers found that in patients who received 6000 rat units or more of hormone, the testicle had a peculiar mottled appearance and was reduced in consistency and size. If 4000 or less rat units were given, the testicle appeared not unlike those of patients who received no therapy at all. In one instance reported by Eisenstaedt et al., the testis had been reduced to a pea-sized organ. These are very distinct degenerative changes and these facts have necessitated revision of our previous conceptions concerning the efficacy of massive doses of hormones.

It might be mentioned, in passing, that a few writers have suggested the use of endocrines as an adjunct to surgery postoperatively and claimed an improvement in their operative results.

CONCLUSIONS

1. Careful study of every cryptorchid is essential before therapy is advised and administered.

2. There is sufficient evidence that endocrine therapy alone will produce descent of the ectopic testis when there is no anatomic barrier.

3. Surgery should be advised in cases in which the testicle is fixed in its abnormal position.

4. Endocrine therapy is of distinct help in distinguishing between those ectopic testes that require surgical intervention because of anatomic factors and those that do not.

5. Hormonal therapy, in proper dosage, is a valuable adjunct to surgery, preoperatively and postoperatively.

THERE is little to suggest that primary tuberculosis of the epididymis ever occurs. It is secondary to some other focus in the body. Its association with other urogenital foci is more common, though it does, at times, occur as the only lesion of this tract.
From—"Office Urology" by P. S. Pelouze (W. B. Saunders Company).

LESIONS OF THE MALE BREAST*

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LESIONS of the male breast are infrequent in the larger medical clinics and very unusual in the average office practice. Therefore, it suffices if the general physician or surgeon has ordinary knowledge concerning the diagnostic possibilities and the accepted forms of therapy. As a rule no aggressive therapy is necessary except in malignant disease which is easily recognized.

The usual textbook states very little concerning the male breast, and the literature, though bounteous, confuses one as to the relative occurrence of various lesions. In this presentation, abnormal processes are subdivided into four groups not because of their scientific accuracy but for simplicity.

CONGENITAL ANOMALIES

Supernumerary nipples constitute the most frequent anomaly, occurring more often in the male than in the female. Landauer[1] records an incidence of 1.94 per cent in men and 1.20 per cent in women. Usually considered as a mole by the patient, these redundant nipples are easily recognized by their appearance and situation along the primitive milk lines of the embryo. No treatment is necessary but local excision with procaine infiltration suffices where cosmetic or esthetic reasons indicate removal.

Hemihypertrophy of the male breast is very uncommon, occurring more frequently on the right than left (Landauer). It can be differentiated from unilateral mastitis by the history of constancy. If therapy is indicated, simple excision of breast tissue with preservation of the nipple as reported by Christopher[2] suffices.

Hemiatrophy cannot truly be said to occur in the male breast and requires no consideration.

TRAUMA

Unlike the female breast, the male breast is uncommonly affected by trauma. Although very vascular, the absence of loose cellular tissue minimizes the chances of hematoma as observed in women. Fat necrosis as described by Lee and Adair[3] in the breast of the obese woman could presumably occur in the male but has not been reported. Ordinary abrasions, contusions and lacerations require therapy similar to those of the skin and subcutaneous tissues elsewhere.

MASTITIS

The term, "mastitis," is almost as evasive in the male as in the female breast. Here it will be used to denote the apparently inflammatory processes strictly non-neoplastic. Andrews[4] in an excellent review of the subject selects the term, "swellings," rather than suffer ambiguity with more scientific terminology. He reported seventeen cases, none of which represented new growth with the possible exception of one case whose material histologically bore some resemblance to adenofibroma. Woodyatt[5] had previously suggested the possible development of adenofibromas from chronic mastitis.

The etiology of mastitis is somewhat problematic. Andrews[4] feels secure in attributing the process to external sepsis due either to poor local hygiene or the presence of surgical infection elsewhere with secondary invasion of the mammary tissue from without. He discusses the observations of Cooper[6] and presents studies

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of his own to show that the male breast is not the very rudimentary organ usually depicted by our texts, but a relatively complex series of ducts and alveoli which should be susceptible to infection. Andrews furthermore believes that gynecomastia represents no more than the usual irritation or infection accompanied by unusual fibrous tissue response. As reasonable and acceptable as the infectious theory appears, one must also attend the possibility of hormonal causation. Wernicke[7] presents a good review from this angle and the evidence suggests a relationship between gynecomastia and the glands of internal secretion, particularly the testicle. Sir Astley Cooper mentions a swelling of the breast in a man with atrophy of one testicle. Of Wernicke's four cases, three had atrophy of the left testicle. However, there was also local trauma to the breast in all four of these patients. Cheatle and Cutler[12] would divide gynecomastia into two clinical types: those associated with abnormal sexual function, sometimes testicular defects, and those in which sexual organs and function are normal. Until further evidence accrues, it appears more conservative to disregard the hormonal relationship, particularly as regards therapy.

Mastitis, including gynecomastia, need not be further subdivided for clinical purposes. It is by all odds the most common lesion of the male breast. Of forty-one lesions observed or treated by Horsley,[8] twenty-three were mastitis of some type. The diagnosis is relatively simple, occurring at any age, characterized by rather rapid appearance of a moderately tender, indurated, button-like mass beneath the nipple. Nipple secretion is rare and fever or leucocytosis is seldom observed. The disease usually endures several months and gradually subsides.

Treatment should be very conservative. It seems unwise to advise surgical excision in a process of this type, but at times excision may be indicated by the chronicity of the inflammatory tissue. The use of endocrine products can be tried if one is optimistic about their usage. Wernicke[7] and Wolf[9] have administered anterior pituitary-like substance. Wernicke also gave these patients testosterone proprionate, which produced some testicular enlargement and a beneficial effect on the breast in two of four cases. In a disease somewhat self limited, one must draw conclusions with care. The usual local heat as applied to low-grade inflammation elsewhere can be used to advantage. The use of external roentgen radiation would appear reasonable in a process of this type but there is a paucity of reports of such therapy. Wolf[9] suggests such treatment but apparently has had no experience. Kaplan[10] advised 150 r twice weekly for four to five weeks but makes no statement as to results. One patient has been treated in the Cleveland City Hospital Tumor Clinic and obviously no conclusions can be drawn.

The granulomatous infections such as tuberculosis and syphilis are too rare to merit attention in a brief review. One interesting paraffinoma, developing two years after paraffin injection, was treated by surgical excision and reported by de Cholnoky.[11]

NEOPLASM

If one restricts the use of the word tumor to connote neoplasm, tumors of the male breast are uncommon and the most common tumor is cancer. The literature tends to be confused as regards ratio of benign to malignant tumors, because of the loose usage of tumor to denote swelling. Billroth (quoted by Andrews) said that benign male breast swellings were rare. Andrews, on the other hand, had not seen a malignant tumor in his practice. Cheatle and Cutler[12] present a composite table in which 87.5 per cent of neoplastic lesions were malignant and 12.5 per cent benign. This ratio probably approximates the correct one for neoplastic disease.

Benign lesions are so infrequent that the average clinician is unlikely to see one. Even the lesion called adenofibroma may, as stated above, represent only mastitis.

Simple excision with procaine infiltration suffices for benign neoplasm.

Cancer of the breast is easily recognized in the male, occurring rarely before the age of 55. It becomes adherent to skin very early, ulcerates early and is attended by considerable pain. Adherence to pectoral fascia and axillary node invasion are common. The decision as to operability may be a difficult one, but in the absence of radiologically demonstrable metastases to lungs or bone, radical mastectomy under general anesthesia should be performed. No attempt should be made to effect skin closure because of the early invasion of skin and the necessity for wide removal. On the basis of our present knowledge, postoperative roentgen irradiation should be given if the axillary nodes show carcinoma histologically. The advanced carcinoma with marked skin and fascia invasion or with inoperable axillary nodes should be treated by irradiation alone.

CONCLUSION

Mastitis is the most common swelling of the male breast and should be treated conservatively until chronicity impels operation.

True neoplasms of the male breast are uncommon. Cancer is the most common of these neoplasms and is easily recognized.

Minor surgical procedures on the male breast are very infrequent in the usual office practice.

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THE SYMPTOMATIC TREATMENT OF ACUTE EPIDIDYMITIS*

A PRELIMINARY REPORT

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ACUTE epididymitis is one of the most painful and incapacitating ailments but has little mortal significance. Since our facilities were not adequate for the hospital treatment of this condition, acute epididymitis was a troublesome problem for the urologic staff. The usual forms of therapy, including such medication as intravenous calcium chloride or gluconate, plus scrotal support, usually afforded the patient little relief, especially when he had considerable distance to travel to his home and bed. It was evident that more effective symptomatic treatment was needed.

Block of the vas deferens with 1 per cent aqueous procaine hydrochloride, as suggested by Imbert,[1] gave but temporary comfort. It was decided to prepare this agent in an oil base to prolong the anesthetic action. We failed in every attempt to produce a clear solution of procaine hydrochloride. We then prepared an oil solution of nupercaine base as suggested by Gabriel.[2] However, this preparation caused a moderate temporary swelling at the site of injection, probably due to phenol.

ANESTHETIC AGENT

The present formula for our anesthetic solution is:

Nupercaine (base)	5
Benzy alcohol	10
Olive oil	qs ad 100

The benzyl alcohol serves as a solvent for the nupercaine (base) and is in itself a mild anesthetic agent. Nupercaine (base) is used since the acid salt precipitates out of solution. Olive oil was substituted for almond oil for economic reasons.

TECHNIC OF INJECTION

The patient is placed in the supine position and the vas isolated between the thumb and forefinger of the left hand as far as possible from the testicle. With the vas held firmly the overlying skin is cleansed with alcohol and anesthetized with an aqueous local anesthetic. A No. 22 caliber needle attached to the syringe containing the oil base anesthetic is introduced into the sheath of the vas. It is practically impossible to pierce the substance of the vas, since its loose sheath affords adequate protection. After the operator has made certain that the needle point is not within one of the vessels of the pampiniform plexus, 0.5 to 1.0 cc. of the anesthetic is injected and the needle withdrawn. It will be noticed that the epididymis is insensitive to ordinary pressure within 30 to 60 seconds after gentle massage over the injected site.

Often the tail and head of the epididymis will remain slightly tender to strong pressure, but the patient can now stand or jump about without the slightest discomfort. A scrotal support is applied and the primary disease treated as usual since we have produced but symptomatic relief without changing the pathologic picture.

The exact duration of the anesthesia is difficult to determine, but is at least four

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to eight days. However, in none of our cases did the anesthesia disappear before the patient's condition had progressed to a painless state, and there has been no recurrence of epididymal pain after the patient has been initially relieved.

CASE REPORTS

In twenty cases of patients with acute epididymitis treated with nupercaine (base) in oil, all obtained complete and almost instantaneous comfort without any untoward effect. No demonstrable change in the disease was observed, except for questionable shortening of its course. A large series of cases will be needed to substantiate this point.

On four occasions we have injected the anesthetic solution into cords, which were markedly inflamed and indurated, with no deleterious effects. In each case pain was instantly alleviated and there was no further enlargement of the cord nor any evidence of spread of infection. The histologic change in the subcutaneous tissue and the subsequent patency of the vas is to be reported at a later date together with additional cases.

SUMMARY

1. Nupercaine (base) in oil injected into the sheath of the vas promptly stops pain of acute epididymitis.

2. The usual treatment for the primary cause of acute epididymitis is necessary since the injection therapy is but a symptomatic measure.

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THE TREATMENT OF ANAL FISTULA IN OFFICE PRACTICE*

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IT might be emphasized at the outset that the treatment of fistula of the anal region in office practice should be the rare exception rather than the general rule.

Most fistulas with an external opening at or near the anal outlet ordinarily are not as simple or uncomplicated as they may seem. Studies of fistulas and sinuses of the anal region by stereoscopic radiographs, after the injection of an opaque solution through the external openings, have demonstrated the serious nature of these conditions.

Fistulas usually originate from perianal or perirectal abscesses which either rupture or are opened by the surgeon. These abscesses in turn usually follow infection of the anal crypts, perianal hemorrhages or trauma. A perianal hemorrhage is usually due to a ruptured hemorrhoidal vein and the resultant hematoma is called a thrombotic hemorrhoid. If its covering is mucosal, it is an internal thrombotic hemorrhoid; while a subcutaneous hematoma is known as an external thrombotic hemorrhoid. If an internal thrombotic hemorrhoid becomes infected and opens internally and externally, a fistula will result. If it opens only internally, it becomes an internal sinus.

Trauma of internal origin affecting a crypt is often followed by abscess formation and ruptures externally producing an anal fistula. Perforating or punctured wounds often produce fistulas.

Any abscess which drains externally usually degenerates into an external anal sinus. These sinuses were formerly called internal or external blind fistulas, respectively.

Multiple complicated and grave fistulas such as those which communicate with pelvic, abdominal or contiguous organs as the vagina, bladder and urethra, must always be considered in dealing with the subject of fistula. However, the treatment of these can be accomplished successfully only in the hospital.

Anal fistulas are so designated because they are located in the anal region, therefore, fistulas whose internal openings are located in the rectum are also beyond the scope of this article.

Most fistulas and sinuses can be diagnosed not only by stereoscopic radiographs as already mentioned, but many can be outlined by injections of colored solutions or pastes through an external or internal opening. The emergence of the colored material through other external or internal openings provides excellent guideposts to their locations. While it is relatively common to see a number of external openings, more than one internal opening is rarely encountered.

The only types of fistulas for which minor surgery can be accomplished under regional anesthesia in office practice are those which after a complete study have been found to be of the simple, uncomplicated variety. Those which either perforate or undermine the external sphincter muscle should not be considered for any type of office treatment. Simple, direct, subcutaneous fistulas can be operated upon in office practice as can small external perianal sinuses.

Internal submucus sinuses can, in selected cases, be opened and drained without hospitalization. A number of simple,

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direct, anal fistulas originating in infected crypts, whose tract runs just underneath the anal lining to the skin, are also amenable to office surgery.

No treatment of a surgical nature should be attempted in office practice unless one has a rest room available where a patient can be allowed to recline for a period after the office surgery has been completed. No matter how small a quantity of any local anesthetic drug is administered, some patients will exhibit a marked reaction or depression following its administration. Allowing the patient to rest from thirty minutes to an hour or two after an office fistulectomy is good insurance against any weakness, reaction or hemorrhage.

Some external perianal sinuses will respond to the injection of bismuth paste and will heal without surgery. This treatment could be tried before surgical drainage is instituted. Bismuth paste consists of one part of bismuth subnitrate and two parts of vaseline. This is thoroughly mixed and sterilized in a hot water bath. A glass sinus syringe with a long curved shank and conical tip is employed for the injection of the paste. The bismuth paste is heated to fluidity. With the patient lying on either side, the conical tip is pressed against the opening of the sinus and the paste injected with gentle pressure until resistance is encountered. If there is more than one sinus, each should be treated likewise. A dressing is then applied and the patient asked to return every three or four days until the sinus ceases to drain.

The majority of external perianal sinuses will not respond to the injection of bismuth paste. These will not heal properly until adequate drainage is provided. *X*-ray studies of these sinuses usually show them to be bottle-necked.

In order to have the sinuses drain properly an incision must be made so that the skin wound is as wide as the widest part of the sinus cavity. It is well to trim back the skin edges so that the incision becomes either an oval or circular opening. Rubber tissue or cellophane is lightly packed into this cavity and is removed in twenty-four to forty-eight hours. It is not necessary or desirable to repack the sinuses as they will heal much more rapidly if allowed to collapse naturally.

The anesthesia necessary for these simple sinuses is the same as that administered for office fistulectomy. Care must be exercised to prevent puncture of the cavity and the injection of the anesthetic solution into it. In order to avoid this the anesthetic injection must be started at least a half inch away from the cavity walls. Then the gloved finger is inserted into the anal canal with the palmar surface directed towards the sinus. This will serve as a guide to the hypodermic needle and prevent puncture of the anal canal during the injection of the anesthetic solution.

Bismuth paste is injected in the same manner for the diagnosis of fistulous tracts. If instead of a sinus a simple direct fistula is present, its direction, extent and the location of the internal opening are disclosed by the emergence of the yellow bismuth paste in sharp contrast to the pink mucosa. We prefer the use of the paste to a colored solution because the paste remains in situ and can be palpated as well as seen. Colored solutions, on the other hand, escape and stain the surrounding surfaces. The paste, moreover, is an excellent lubricant for the passage of a soft flexible wire probe which we use, not only as a diagnostic instrument but as a tractor when the ends are twisted together.

After the surrounding surfaces are infiltrated with a ½ to 1 per cent metycaine solution, particularly all tissues beneath the fistula, the tractor is of material assistance in the fistulectomy. Parallel incisions are made on either side of the wire converging outside of the external and just beyond the internal openings. With gentle traction on the tractor these incisions meet in a V-shaped manner below the fistula and it is excised threaded on the probe.

Ligatures are not necessary unless arterial bleeding is encountered. Usually the

coagulating current or cautery will control the bleeding. A strip of rubber tissue or cellophane is placed in the wound as a drain, then a gauze compression bandage and a pad supported by adhesive strips are applied. The drain is removed in twenty-four to forty-eight hours and as a rule, not replaced. These simple fistulas heal in a very few days and the patient is not compelled to abstain from his usual duties.

The whole subject of surgery of the fistula is one of the most important in the whole field of proctology. The successful treatment of a complicated and often times a simple direct fistula will tax the ingenuity of the most skillful specialist. For that reason, a note of extreme conservatism will be seen throughout this short article. It must be remembered that the demand for office treatment of not only fistulas but other anorectal conditions as well emanates from those who wish to avoid hospitalization.

General anesthesia was another matter to which many patients objected because of unreasoning fear or prejudice. With the almost universal employment of nonsleeping types of anesthesia by proctologists in the majority of anorectal operations, this objection is no longer valid. Of course, certain unethical practitioners who are denied hospital privileges, stress office treatment and office surgery, and play upon the prejudices of the bewildered patient against hospitalization for anorectal diseases.

The employment of regional, caudal and low spinal anesthesias has robbed anorectal surgery of many of the imaginary terrors which existed only in the minds of the uninformed. These types of anesthesia have rendered the operation not only easier, because of better relaxation of the parts, but also have actually shortened the period of hospitalization to such a marked extent that prospective patients are no longer so apprehensive.

While the limitations of proctologic surgery in office practice are governed to a large extent by the ability, skill and equipment of the individual surgeon, a warning note should be uttered less the uninitiated be led astray by overenthusiasm.

I would conclude by advising that every patient suffering from a fistula or sinus be given the benefit of hospitalization even for a short period, rather than be forced to undergo an operation, which in office surroundings may be incomplete and sometimes disasterous.

ANAL FISSURE: ITS OFFICE TREATMENT*

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OF all the affections of the anorectal region, the one that causes the most pain and suffering in proportion to its size is a fissure. Fissure as its name implies, is a traumatic condition: a split, tear or laceration of a crypt or the wall of the anus or anal canal. This may be caused by any sudden exertion or strain such as sneezing, coughing, laughing, vomiting, purging or lifting. All may be responsible for the sudden traumatization of the anal transitional lining.

The passage of unusually large, hard or irritating liquid stools also may produce a laceration of this membrane. Other causes may be the expulsion of either large or small foreign bodies which either split the lining membrane of the anal canal, or if small enough, enter and sometimes tear the anal crypts. Anal papilli may also be torn and this laceration produces the symptoms of fissure.

If the fissure persists either because of neglect on the part of the patient to seek relief, or because of inadequate or improper treatment, ulceration and induration take place. The condition is then no longer a fissure but an ulcer. Anal ulcer is what was formerly and erroneously called "chronic fissure."

The chief symptoms of anal fissure are pain, sudden in character, bleeding, which is sometimes very slight, and sphincter spasm. On account of the pain produced by a bowel movement the patient postpones future evacuations as long as possible. When defecation is imperative, the fissure tends to split further and the symptoms unfortunately increase in severity. If, on the other hand, in order to avoid constipated stools, hypercatharsis is produced by the overanxious patient, the fissure symptoms are further aggravated by the frequent, copious, irritating, liquid fecal discharges.

While fissures occur in an otherwise normal anal canal as a result of trauma, as has been stated, this injury is more apt to happen in an individual who already has some pathologic condition such as hemorrhoids, cryptitis, papillitis or ulcerative or other inflammatory conditions of this area. Many times the patient and sometimes the physician is apt to make a snap diagnosis of "hemorrhoids" because of the presence of anal pain, bleeding and the swelling produced by the formation of a "sentinel pile." This latter condition is not a true hemorrhoid, of course, but a swollen, edematous and infiltrated crescentic fold of skin which forms at the outer angle of the fissure. While this acts as a buffer, it usually prevents good healing, and its removal is necessary to the successful treatment of fissure.

The diagnosis of fissure is easily made. A history of strain, trauma, constipation or diarrhea followed by acute spasmotic pain, which recurs with each bowel movement, should at once suggest the presence of a fissure. While some fissures do bleed noticeably, a stain on the clothing or toilet paper or a blood streak on the stool may be the only evidence of hemorrhage.

Usually the presence of a sentinel pile will indicate the location of the fissure. Before making a digital or instrumental examination the insertion or application of an anesthetic ointment is recommended. One containing 1 per cent of diothane, eucupin, metycaine, novacaine, anesthesin or other surface anesthetic is of great assistance in making an otherwise uncomfortable examination one which is

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surprisingly easy for the patient to tolerate. In some cases this may not suffice, particularly if the patient is exhausted, nervous or irritated from continued suffering.

The sphincter and surrounding tissues should be anesthetized by infiltration. After sterilizing the surrounding skin, 2 or 3 cc. of one of the anesthetic solutions preferred by the surgeon should be injected about 1 to 2 cm. behind the posterior commissure, and the injection carried up on either side of the anus in a V-shaped manner until at least half of its circumference has been anesthetized.

If, however, the fissure is located anteriorly, the injection must be carried all the way around the anal orifice. The injection should also be carried well underneath the base of the fissure. This can be easily accomplished after the initial anesthetization of the external sphincter. Digital and anoscopic examination can be accomplished after waiting two to three minutes and frequently the therapeutic measures indicated can be applied without further anesthesia.

Sometimes the fissure can be felt by digital examination, particularly if the edges have become indurated. It is our practice in making a digital examination to employ the little finger before the index finger. By doing this, most of the unpleasant part of a digital examination in a patient with a fissure is eliminated. Through a small anoscope the fissure looks as one would expect it to appear, namely, a crack through the transitional membrane which lines the anal canal and sometimes into the perianal skin. It is the extension into the perianal skin which usually produces the sentinel pile. If a larger sized instrument is used, the fissure, particularly after a local anesthetic has been injected, will appear more as an oval or rounded abrasion rather than a crack. This is due to the infiltration and the stretching of the lesion.

In office practice, two lines of procedure present themselves, one the nonoperative, and the other the surgical method. Both are based on the principle of temporarily putting the affected portion of the external sphincter out of commission. This provides physiologic rest and allows the affected part to heal in a short time.

Before instituting treatment of any kind, the patient should be informed that a nonsurgical procedure is often merely a palliative measure and postpones surgical treatment until a later date. In many of the cases, however, injection of a lasting anesthetic will be all that is necessary. This type of treatment should be reserved for those individuals who refuse even a minor surgical procedure or who are unable to be absent from their duties for even a day or two.

Technic. The patient is placed in either the right or left lateral position. The skin is then prepared according to the technic preferred by the surgeon. We use alcohol and one of the mercuric tinctures. The injection is carried on as described previously. When skin and sphincteric anesthesia is completed, 1 to 3 cc. of either a watery or oily solution is slowly injected underneath the entire fissure and to either side. The needle is guided by a finger inserted into the anal canal. This also prevents the accidental puncture of the anal lining. If a watery solution is used, 1 per cent diothane or eucupin, 2 per cent quinine urea hydrochloride or 2 per cent nupercaine solutions are all employed for this purpose. If an oil soluble anesthetic is used, a 5 per cent solution of eucupin ordiothane in a vegetable oil is chosen. It should be heated to about 100°F. and a needle of a caliber not smaller than 20-gauge used. After sufficient solution has been injected under the entire fissure including the sentinel pile when present, the solution particularly if oil is distributed through the tissues by finger massage. If an oil solution is injected, a single injection is sometimes sufficient to put that portion of the sphincteric circumference at rest long enough to provide enough physiologic rest for complete healing. The patient is

instructed to take a sufficient quantity of an intestinal lubricant to guard against constipation or impacted stools. Cathartics are interdicted because liquid stools irritate the fissure.

If complete relief is not obtained injections may be repeated at intervals of four to seven days. The watery solutions as a rule do not produce as long a period of anesthesia as the oil. As long as anesthesia is produced, it is our usual practice to excise the sentinel pile and to incise the entire fissure bed. Overhanging edges may occasionally require trimming and the only vessels which need to be ligated are spurting arteries. Venous oozing is quickly controlled if quinine urea postoperative anesthesia is used, or oozing may be stopped by the application of the electrocautery. In most of the cases the application of a firm gauze dressing is all that is required.

It is important when incising a fissure that the sphincter fibers be exposed and at least the presenting fibers be served. The outer edge of the external sphincter muscle should be incised more deeply than the internal so as to provide better drainage. A strip of rubber tissue or cellophane should be placed in the wound for twenty-four hours unless gauze pressure is desired. The patient is allowed to rest for fifteen to twenty minutes when, provided the wound is dry, he can be dismissed to return the following day for dressing. It is surprising what a large percentage of simple fissures will respond to the injection or incision treatment in office practice.

When the fissure is complicated by the presence of other rectal disease or has become a chronic indurated anal ulcer, hospitalization which is usually of very short duration should be advised.

The limitations of office methods in the treatment of patients suffering from anal fissure is measured only by the skill and the experience of the proctologist or the surgeon in charge of the case.

OFFICE TREATMENT OF HEMORRHOIDS*

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VERY few people have any desire to enter a hospital for an operation. No one wants to lose time from his work or business and there is a universal urge to avoid pain or suffering. The public puts constant pressure on the physician to avoid hospitalization and surgery.

Unscrupulous practitioners have publicized the office treatment of hemorrhoids as a semimiraculous method which involves no pain or time loss and eliminates the inconvenience and economic hardship of hospitalization. In the guise of treatment, rather than operation, a general anesthetic may be given and with inadequate assistance and with only the ordinary equipment of an office, an attempt is made to relieve the patient. It is difficult enough to do good work in a well equipped operating room with plenty of assistance; but to operate in an office—call it a treatment—and to allow the patient to attempt to go home afterwards is little short of folly.

The ethical proctologist knows the so-called short cuts, the office or ambulant methods, their possibilities and their limitations. He knows that there are certain definite types of hemorrhoids which are suitable for office treatment. He knows also that if most patients with complicated hemorrhoids realized the time to be consumed and the prolonged period of inconvenience involved in office treatment, they certainly would choose to have the whole thing done at once in a well equipped operating room under local anesthesia.

Hemorrhoids are essentially varicose veins in the region of the anus. The tendency to have varicose veins, including hemorrhoids, is familial. Certain members of a family may escape; others, who are subjected to long hours of standing, lifting, or strenuous labor, develop hemorrhoids. Straining such as with constipation, diarrhea or childbirth tends to cause bleeding, protrusion and pain. School teachers, policemen, motormen, clerks and others whose occupations cause them to stand still for long periods are likely to have hemorrhoids. Intra-abdominal conditions which disturb the return flow of venous blood are a definite factor in some cases.

Hemorrhoids first appear within the anal canal above the external sphincter. As they become more prominent with the straining at defecation, they protrude through the anal opening. With each protrusion the anus is dilated, thus paving the way for more extensive protrusion. This may happen not only with every bowel movement but with every act of stooping or lifting. The patient may have to replace his hemorrhoids many times daily.

At intervals these veins may begin to bleed with bowel movements or any unusual strain. As time goes on the bleeding may occur with every stool. The surface of the hemorrhoids may become inflamed and ulcerated so that it is impossible to have a bowel movement without bruising the thinly covered veins. In constipation repeated bruisings by hard stools open a path for infection.

Small foci of infection heal with the formation of fibrous tissue. This tends to contract the anus, producing more constipation and more difficult passage of stool with greater damage. Thus a vicious cycle of more damage exists and more spasm is established.

After the passage of an excessively large stool or with straining of diarrhea or childbirth, or, after prolonged standing or following a drinking bout, one of the external

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veins may suddenly rupture. The extravasated blood in the perianal tissue clots and forms a thrombotic hemorrhoid.

Less frequently a similar rupture of internal hemorrhoidal veins occurs. Large internal hemorrhoids may prolapse and the sphincter may contract and constrict them so they can not be immediately replaced. A huge and painful thrombus develops. The entire perianal ring becomes swollen, edematous and fragile. With sufficient disturbance of the circulation, large areas may become ulcerated and gangrenous, and the area may lose all semblance to a normal anus.

Thus there are many types of hemorrhoids and degrees of severity. We may have internal bleeding or protruding, interno-external bleeding and protruding, thrombosed external veins, thrombosed internal veins and complications such as infection, muscle spasm, scarring, infected crypts, polyps, fissures, abscess or fistula. Only certain types of hemorrhoids are suitable for office or ambulant treatment. Selection of suitable cases for this type of treatment is all important.

Simple internal hemorrhoids which may be bleeding or protruding are successfully treated in every proctologic office. This is best accomplished by the injection method but the same result can be attained by the galvanic current, although with much more time and trouble.

An injection of a mild escharotic solution into the upper end of the hemorrhoid produces a sterile inflammation. In the subsequent pouring out of serum, fibrin and fibroblasts, the varicose veins are squeezed and constricted by scar; the mucosa is tacked to its underlying structures and instead of a large bleeding or protruding mass of veins we finally have a flat, slightly indurated area on the wall of the rectum. There are usually three hemorrhoids: left lateral, right anterior and right posterior. If all three are injected at one time, the venous circulation can be disturbed sufficiently to develop an immense ring of external edema.

It is best to inject only one hemorrhoid, or two at the most, at one time. Five to seven days later another hemorrhoid may be injected. Occasionally there are small collateral veins which can be given a smaller injection. After the three main hemorrhoidal masses are injected, it is best to wait for three to four weeks until the induration has resolved before repeating the injection. Most proctologists agree that 5 per cent quinine and urea hydrochloride in 1 per cent novocain is the best solution to use. Five per cent phenol in Wesson or almond oil is probably the next choice. Many different but similar preparations have been used.

Two to 3 cc. of 5 per cent quinine and urea hydrochloride is placed in a 5 cc. syringe and a straight twenty-two gauge three inch needle fitted to it. The patient can be treated in the knee-shoulder or left Sims' position. A gloved finger well anointed with a water soluble lubricant is inserted into the anal canal.

A short beveled anoscope is passed with the obturator which is opened toward the known location of the hemorrhoid to be injected. If the patient is asked to bear down slightly, the veins will fill up and the most favorable location for injection can be chosen. The solution should be injected into the middle and toward the upper pole of the mass. An injection near the distal pole of the hemorrhoid may produce severe pain and sphincter spasm.

Under a good light the spot for injection is sterilized with one of the various mercurial antiseptics by means of a cotton applicator. One to 2 cc. of the solution is injected depending on the size of the hemorrhoid. There may be a slight sensation of burning but usually no actual discomfort.

The patient can get up immediately and go about his usual occupation. He is advised to use local heat in the form of a hot sitz-bath or hot compress that evening if he has any bearing down, discomfort or pain. He is advised to replace these masses immediately should they prolapse at his home and is warned that failure to do so

may result in strangulation. The injection is made through a mucous membrane surface that is constantly bathed with germs, therefore, every precaution should be taken so that the solution, equipment and site of injection be properly sterilized.

For the few patients sensitive to quinine, phenol and oil can be injected but it is necessary to have the solution slightly warmed and to use a needle of larger bore. If the patient is examined on the next day, an indurated mass can be felt, much larger in size than the original hemorrhoid. Subsequently, this mass becomes less indurated and smaller. If the hemorrhoid which bleeds the most or protrudes the worst is first injected, bleeding or protrusion may be stopped at once with a single treatment. It is no wonder then that the patient believes he has been cured miraculously. At the time he would be willing to write a most glowing testimonial. If the patient will return for further injections, the veins can be so completely sclerosed that a cure is finally effected.

Many thrombotic hemorrhoids are amenable to office or home treatment. Thromboses after childbirth frequently causes more discomfort than the childbirth itself, and surgery is contraindicated at that time. Hot glycerine compresses covered with oiled silk and a hot water bag do much to relax the spasm and reestablish proper circulation. Rest in bed allows the veins to empty easily, and applications of any soothing ointment is comforting. By the time the patient is able to be up and about most of the thrombi have been absorbed.

The ordinary external thrombosis can be treated palliatively as above, or more rapidly by injecting a local anesthetic and removing the clot. Simple incision and liberation of the clot are frequently followed by a recurrent clot. It is better to remove a radial wedge-shaped piece of tissue including the clot, and, if necessary, ligate any small spurting vessels. A gauze, pressure dressing is applied and the patient is advised to have his dressings changed frequently. Mineral oil daily by mouth lubricates the anus and hot sitz-baths will relieve any postoperative discomfort.

In many instances thromboses are a useful warning. Many patients would never have a rectal examination if they did not have a painful thrombus. Its presence calls for a careful and complete rectal examination. To dismiss such patients with a sample box of suppositories is gross carelessness. Neglecting to examine the rectum may result in missing an early carcinoma.

Interno-external hemorrhoids can sometimes be injected. Caution should be exercised in treating this type in the office. It is true that the internal hemorrhoids can frequently be treated satisfactorily by injection, but what happens to the external hemorrhoids? Since they can not be injected, they must be removed surgically. It is possible to remove them one at a time in the office but that is like cutting off the dog's tail by inches.

Although a patient may not have simple internal bleeding or protruding hemorrhoids, there are times when injection treatment for at least temporary relief should be used. A tuberculous patient with active chest lesions should not be subjected to hemorrhoidectomy. There is a real danger of opening up the area to the tubercle bacilli swallowed. Aged patients may be carried along with injections. It is not a cure but does give the patient some symptomatic relief. The patient with severe secondary anemia may be slow in healing after surgery. Preliminary injections can be used to stop the bleeding temporarily so that the patient can be built up and hemorrhoidectomy performed safely later on.

Patients whose only complaints are bleeding or protrusion too often fail to consult their physicians. Some patients will replace their protruded hemorrhoids daily through a long life. How many times do we see patients who have bled at intervals over a period of years, some to the point where they have severe secondary anemia.

Pain is the symptom which drives most hemorrhoidal patients to the physician. Pain is evidence of a complication, which may be infection, fissure, sphincter spasm, edema, polyps or abscess as well as hemorrhoids. This is the type of hemorrhoids most often seen in the physician's office. To attempt office treatment of complicated hemorrhoids is foolhardiness. If the sphincter is relaxed at one sitting, polyps or papillae removed at another, internal hemorrhoids injected at other visits, and fistulae incised a part at a time, the patient can scarcely be thought successful in his effort to avoid pain. Injection of hemorrhoids in an infected rectum with a tight sphincter invites abscess formation and intensifies spasm and pain. Most attempts at ambulatory treatment of this type rapidly bring the patient to the point of begging to enter the "dreaded" hospital where he knows he will get relief.

Office treatment of hemorrhoids unfortunately has been offered to the public as a miraculous means of avoiding surgery and hospital confinement. The injection treatment is a measure of great value if care is exercised in the choice of patients. If used on patients with internal hemorrhoids, which bleed or protrude, it is ideal since both complaints can be relieved promptly and painlessly. The slight loss of time and the economic saving will appeal to many. It can also be of great help, at least for temporary relief, in the aged, anemic, tuberculous and pregnant. To attempt its use in the treatment of hemorrhoids complicated by other pathology frequently spells disaster. Office treatment is not a cure-all, and, there are definite limitations to its use.

ANAL CRYPTITIS AND PAPILLITIS*

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THE term, "anal cryptitis and papillitis," denotes the condition produced by inflammation of the anal crypts and papillae, characterized by symptoms and changes described later. Because of frequent and varied distressing symptoms occurring in the anal canal caused by these conditions, it may be well to review briefly the anatomy of these important structures. The closed anal canal is thrown into folds, columns and depressions to compensate for the dilatation necessary for the passage of formed feces. These columns are known as the columns of Morgagni. Between the adjacent columns and placed transversely are the semilunar valves, which form the lumen boundary of minute pockets known as, "anal valves, rectal pockets, mucous crypts or crypts of Morgagni." The mouths of the crypts open upward and against the fecal current, which predisposes them to the likelihood of forming catch basins for particles from the fecal contents of the rectum. The number of crypts vary, usually from four to twelve, and when not inflamed are hardly noticeable.

At the edge of each semilunar valve a toothlike or teat-like projection is found called the *anal papillae*. They are composed of a framework of connective tissue, blood vessels and nerves, covered with squamous epithelium and contain some erectile tissue. The papillae and crypts are situated at the junction of the anal canal with the lower end of the rectum and form an irregular serrated line known as the *linea dentata*. Normal papillae are small and may be almost indiscernible, but with inflammatory change may become hypertrophied. Because of these changes, the definite clinical entities, cryptitis and papillitis, occur more frequently than is generally believed.

The etiology of cryptitis is usually that of some foreign body lodging in the anal crypt. The more common among these are particles of bran, small seeds, fragments of bone, egg shells, tooth brush bristles, pieces of tooth picks, feces or bacteria. Because of the shape of the crypts, retained material is not readily expelled and decomposition results with ensuing injury to the mucosa and infection. This, in turn, produces a hypertrophy and increase in the depth of the crypt from a few millimeters to a deep sinus with resulting irritating discharges.

If the mouth of the crypt remains intact, the secretions are expelled into the anal canal producing irritative symptoms. Should the mouths of the crypts become sealed, the complications of cryptitis such as, pruritus, fissure, abscess and fistula-in-ano are likely to result.

Practically speaking, the infected crypt is the primary etiological factor in all anal abscesses with the exception of those due to trauma. If the infection in the crypt makes its way through or around the anal sphincter, a perianal abscess is formed; but if the crypt breaks down and drains into the anal canal, a fissure-in-ano results.

However, it should be constantly borne in mind, and is more often overlooked, that anal crypts afford one of the most fertile foci of infection of any area in the body. Cultures from inflamed anal crypts will reveal that many varieties of pathogenic bacteria are harbored there, especially many strains of the streptococcus. Due to the unusual anatomy of the anal crypts,

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retention and absorption of toxic material into the lymphatics and blood stream is definitely favored.

Symptoms. The symptoms of anal cryptitis may be loosely classified as local, occurring in the anal canal and perianal region, and remote or reflex to other organs. The local symptoms may vary from simple excoriation, burning, itching of the perianal skin caused by discharge from the crypts, to a pricking, uncomfortable, dull aching sensation in the less acute cases; while in the acute cases there is sharp, piercing, burning pain exaggerated by defecation, lasting from a few minutes to several hours with usually a marked spasticity of the sphincter ani muscle. Constipation often results because of the patient's fear of the pain that is produced by defecation. The more remote or reflex symptoms usually encountered are those that simulate dysmenorrhea, dysuria, prostatitis, low back pain, lower abdominal pain and tenesmus. These symptoms ordinarily subside as the inflammation of the crypts becomes less acute.

The symptoms of papillitis are described as tickling, picking, crawling (as if worms were crawling in the anal canal), and often after defecation the sensation of an incomplete evacuation and desire to return immediately to stool. This sensation is due to the hypertrophied papillae being engaged in the grasp of the anal sphincter. Pain is not a prominent symptom in papillitis and occurs, as a rule, only when a papilla has been dragged down and its base torn, producing the painful symptoms of fissure-in-ano.

Diagnosis. Diagnosis of cryptitis is frequently missed because of improper examination. Any of the above symptoms will lead one to suspect this condition, but actual visualization of the inflamed crypt proves the diagnosis. The examination should proceed as follows: A relaxed finger covered with a rubber cot well lubricated is gently inserted into the anus as the patient strains down (this is important, as it relaxes the sphincter which is usually very sensitive and spastic). Crypts are not palpable though the tender points may be located by gently rotating the finger in the anal canal. The principal reason for the digital examination as the primary procedure is that if a foreign body is present, further damage is obviated by gentle palpation. Next, a well lubricated, cylindrical anoscope is gently inserted into the anal canal, in the same manner as that of the finger, and with good illumination, each quadrant is systematically searched for inflamed crypts. A hypertrophied crypt is plainly visible; but to determine the size and depth, the crypt should be explored with a hook-shaped, small, malleable, silver wire probe with an olive tip, which is inserted behind the semilunar valve and the pocket explored without danger of injuring the fragile mucosal lining. If the mucosa is injured, complications will result. With the careful execution of the above, the crypt will often be found to extend to the anal skin margin. This knowledge serves as a valuable aid in treatment.

The diagnosis of papillitis is accomplished by the same manner of examination as for cryptitis. However, hypertrophied papillae are often palpable as small, firm, fibrous projections, but here again visualization through the anoscope is the most accurate method of diagnosis. The papillae are seen as tooth-like or teat-like projections extending into the lumen of the scope and vary in length from one-fourth to more than one inch in length. Hypertrophied papillae are easily differentiated from anal polyps, in that the papillae always have a wider base than tip and the tip is pointed; while a polyp has a bulb-shaped tip, which is usually wider than its pedicle and base. Papillae are, as a rule, more numerous than anal polyps.

TREATMENT

The treatment of cryptitis may be surgical or medical. The common consideration given both, however, is a diet that is bland, excluding the use of harsh

laxatives, condiments and alcohol. Mineral oil should be administered each night to insure soft nonirritating stools until the acute symptoms subside.

Medical treatment consists of the local application of such agents as icthyol, argyrol, mercurial tinctures or the careful cauterization with phenol or silver nitrate triweekly or oftener. The painful symptoms may be allayed by the use of anesthetic suppositories, ointments and the application of heat. These methods tend toward the amelioration of symptoms but are in reality only palliative, since acute exacerbations often occur.

Surgical treatment offers the most effective method of treating cryptitis and papillitis as well as disposing of the foci of infection. In surgical treatment of the anal canal as an office procedure a guarded prognosis should be given, as the slow, resistant healing of anal fissure is often encountered. All surgical procedures are necessarily effected through the limited space of an anoscope and without complete anesthesia and relaxation of the anal sphincter; thus, simple incisions of the mucosa may result in troublesome or dangerous hemorrhage.

Then the inflamed crypt has been identified, the mucosa is distended within 1 per cent novocaine, followed by the injection of a few minims of ½ per cent quinine urea or diathane solution. The latter are chosen for their prolonged anesthetic properties. With scalpel or cryptotome, the crypt is incised in its full extent, parallel to the longitudinal axis of the bowel. The incision should extend well out on the perianal skin, paralleling the radial skin folds, thus preventing cupping of the wound and insuring prolonged drainage. If the mucosal edges are redundant or if there is a papilla present, they are removed by excision of the edges of the wound with scissors. Initial hemorrhage is controlled by the pressure of a cotton-tipped applicator and the base of the wound is cauterized with phenol or 10 per cent silver nitrate.

The excision of hypertrophied anal papillae is essentially the same as that described above except that the bases of the papillae are crushed with a small hemostat, which is left in place for a few minutes, and the papillae are removed by incision through the compressed line of tissue with scissors. The line of incision should extend well out on the skin margin as above.

The after-care of these wounds is most important. If the edges are allowed to bridge across or granulate too freely, healing is delayed. This is prevented by digital massage and inspection with the anoscope at regular intervals. Excess granulation is prevented by cauterization with 10 or 25 per cent silver nitrate carefully applied.

PILONIDAL SINUS*

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THE term, "pilonidal sinus," refers to a vestigeal remnant frequently found in the skin and subcutaneous tissues of the sacrococcygeal region. At the most typical period of its development the sinus or cyst contains hair, whence its name, "hair nest." It is subject to degeneration and infection, giving rise to a characteristic clinical picture.

ETIOLOGY

There has been much speculation as to the origin of these sinuses. Many hypotheses have been offered to explain their occurrence. Some authors believe that the condition is the result of an infolding of skin with inclusion of pilogenetic cells. Others consider them as remains of the primitive neurenteric canal. Recent work, particularly by Fox,[1] has suggested a striking analogy to a gland which is located in birds, certain of the reptiles and other lower forms which is known as the preen gland. This gland is situated in the sacrococcygeal region and secretes an oil with which the bird strokes its plumage. The secretion not only lubricates the feathers but is thought to play a role in sexual attraction. Whichever theory is ultimately accepted as to origin, the constant location, the characteristic pathologic picture, the relationship to adolescence and its familial tendency should be satisfactorily explained.

Pilonidal sinuses are found mostly in persons of the pituitary type, tall and obese, with broad hips and hairy bodies. However, the sinuses may also occur in persons not of this habitus. At the present time Dr. Robert C. Moehlig and the writer are investigating the role which the pituitary gland may play in the sinus development. The results will be reported later.

In the white race the condition predominates in males over females in the ratio of about three to one. It has been stated that the condition is rare among negroes. However, among the many colored patients attending the Detroit Receiving Hospital, pilonidal sinus has not infrequently been observed. Here may be noted a paradox that among negroes the ratio of occurrence in males rather than females is reversed; colored women have the condition much more commonly than the men. The negress with pilonidal sinus tends to be fat and broad-hipped.

There is a definite familial tendency. It is not uncommon for several brothers, sisters or other relatives to have pilonidal sinuses. It is interesting to note further that in these families there tends to be an unusually large number of twins. In 1936, I reported a group of forty cases[2] in which more than the normal percentage of twins were found among the relatives of those having a pilonidal sinus. Mechling[3] and Goldberg and Bloomenthal[4] have noted its occurrence in identical twins.

As previously reported[2] the onset of symptoms occurred between the ages of 15 and 20 in 40 per cent of the patients, and between the ages of 20 and 25 in 45 per cent. This seems to indicate a relationship with the body changes of adolescence.

Fitting the clinical facts with an explanation of the pathogenesis of this condition, it might be assumed that at birth an embryonic remnant of a vestigial secondary sex gland may be present, which is constantly located in the sacrococcygeal region. This apparently plays a greater role

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in the male than it does in the female. The embryonic rest, while present during infancy and early childhood, remains quiescent. Then adolescence occurs and under the stimulus of the pituitary and other hormones that induce secondary sex characteristics, the hair on the body, etc., this gland, too, is activated; and, as it becomes activated, hair develops. The process continues during early puberty until late adolescence when the hair and the rest of the cyst tends to undergo degeneration. At this stage, pain, swelling and discharge occurs and the patient consults a physician.

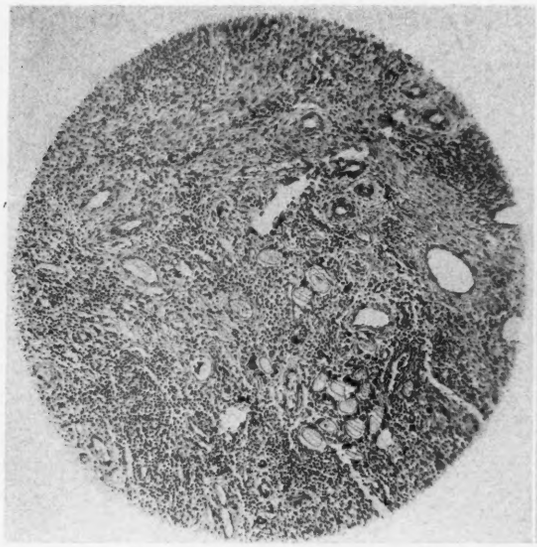

Fig. 1. Characteristic section of a pilonidal sinus. Note the presence of numerous hair follicles and the beginning of fibrosis.

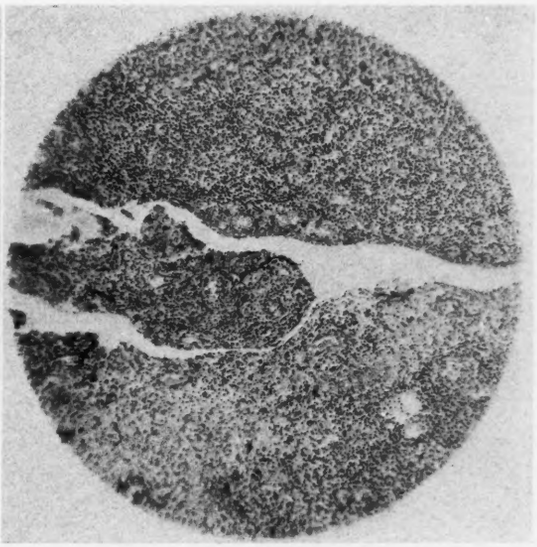

Fig. 2. Later stage. Hair has disappeared. Degeneration is almost complete and suppuration is present.

SYMPTOMS

The patient usually presents himself by reason of pain or discharge. Sometimes there is a story of possible injury. Careful history taking may bring out the tendency to discomfort in this area for a considerable time. Often the patients will tell of previous abscesses that have been opened or have spontaneously ruptured. Routine examination may disclose the presence of a pilonidal sinus without any symptoms.

DIAGNOSIS

Diagnosis is simple. The sacrococcygeal area is carefully inspected. The skin may be wiped with alcohol to remove any oily secretions. In the mid-line there can be seen from one to five tiny, pin-point openings running vertically in an almost straight line. The presence of these cribiform openings absolutely clinches the diagnosis of pilonidal sinus whether or not symptoms have ever been present.

When degeneration and infection have set in there may be seen or felt a deep, rounded swelling usually to one side or another, or scars may be present marking the site of former drainages. Openings of sinuses and fistulas may honeycomb the skin over the sacrococcygeal region extending upward for many inches or outward into the buttocks.

These tracts tend to run upward and do not communicate with the rectum. The infection generally spreads in the cutaneous tissues; the tough aponeurosis over the sacrum limits its course. Cases have been reported of osteomyelitis of the sacrum developing as a complication. While this is possible, its occurrence must be most uncommon.

TREATMENT

Treatment is essentially surgical. In the presence of acute abscess formation it is well to drain the abscess and allow the

acute inflammatory process to subside before undertaking radical removal. This simplifies the later operation by permitting more accurate dissection and securing clean cut lines of cleavage. If removal is done during the acute suppurative stage, there is much necrosis present, making neat block dissection difficult. Some of the cases thought to be osteomyelitis of the sacrum may have been those in which the necrotic process made the deeper portion of the cavity so friable that it could not be separated from the underlying periosteum.

Fig. 3. Pilonidal sinus showing cribiform openings and abscess formation.

The abscess may easily be opened in the office. It is rarely necessary nor is it adviseable to infiltrate with local anesthesia. The skin may, if desired, be sprayed with ethyl chloride or a thin line of phenol spread to deaden sensibility. However it can usually be done without any anesthetic. A pointed blade with sharp side up is stabbed into the abscess. It is then withdrawn, cutting its full length from within the cavity out. This procedure is far less painful than pressing downward upon the suppuration.

Considerable foul-smelling pus will be evacuated with immediate relief. Rarely is there difficulty with hemostasis, but a small packing may be inserted to prevent oozing. Packing, if placed, should be removed the following day. The wound is kept clean and some mild antiseptic dressing applied.

We have seen two patients during pregnancy with abscesses developed in pilonidal sinuses. In both these cases the abscesses were drained in the office and operation deferred until after the confinement.

Fig. 4. The wound is left open after the sinuses have been removed en bloc.

Ordinarily, after ten days surgical removal may be undertaken. To be successful there must be wide dissection of the involved tissues, preferably en bloc. Some surgeons employ methylene blue or other dyes to outline the tracts. This is rarely necessary. In fact the use of dyes is misleading because the scar tissue is so thick that small lateral sinuses may not be stained.

The radical removal of a pilonidal sinus is a major surgical procedure which, except in the very small or latent cysts, is not adapted to office treatment. Spinal anesthesia (50 mg.) is ideally suited to this purpose. Local anesthesia is often impractical because of the extent of the dissection and the presence of scar and pus. Caudal block is not advised because of the involvement of tissue just at the site of the insertion of the needle. The prone position best suited for operation makes inhalation anesthesia difficult particularly as the individuals tend to be fat.

Probes are passed through the sinuses upward to their full length. The palpating finger as well marks the apparent extent of the involvement. Beginning cephalad an elliptical incision is made pointed at both ends. After cutting through the skin the

fat is dissected well back on both sides. The tissue to be removed is steadied by an Allis forceps. The area is vascular and hemostasis should be controlled as the dissection proceeds.

When the sacral aponeurosis is reached the involved tissue can usually be separated by light, sharp dissection aided by gauze or the finger. If a definite line of cleavage can be maintained, the operation will be quicker, cleaner and the end result more sure. Chopping, tearing, and piece-meal dissection should be avoided if possible. About mid-way down the sacrum a branch of the middle sacral artery will be encountered that usually requires ligature by needle through the fascia and periosteum. After the block has been removed, all bleeding points are tied and the wound carefully inspected for any suspicious bits of sinus. If found, they are excised.

Many ingenious methods have been devised to correct the gap left by the cyst removal. These methods include complete primary suture with or without drainage; partial closure; plastic flaps; transplantation of portions of the gluteus maximus; marsupialization of the cyst wall, and others. These technics, in the hands of their devisors, are reported to work successfully. However, taken by and large, the most happy results have come from the open method. Kleckner,[5] in 1936, canvassed the members of the American Proctologic Society and the returns indicate that 87 per cent of these men with wide experience preferred the open method.

Rogers,[6] in 1933, analyzed a series of 119 patients treated over the years in the Massachusetts General Hospital. The matter of recurrence was particularly studied. In cases closed by primary suture, recurrence occurred in 36 per cent; with partial closure, 50 per cent; whereas those left for open healing recurred in only 18 per cent. Primary suture attempted in recurrences failed in every case. As part of the study, the patients were interrogated as to their satisfaction with the treatment, and it is interesting to note that those with primary suture complained of itching, pain, irritation, numbness and tenderness in the scars to a greater degree than did those whose wounds were allowed to heal by the open method.

It has been my practice to leave the wounds open. While the time of healing may in this way be prolonged, the end results have been very satisfactory. During the postoperative course, should any signs of recurrence or unhealthy granulations appear, the involved area can be cauterized either by some chemical agent or by the fulgurating needle.

Accordingly, after the surgical dissection has been completed, the wound is packed lightly with vaseline gauze and a tight bandage placed, adhesive straps being utilized to draw the buttocks together and relieve tension on the margins of the wound.

AFTER CARE

The vaseline gauze pack is left for forty-eight hours. It is then removed and a substitute dressing of 5 per cent merchurochrome or other mild antiseptic is employed. There is considerable mucoid secretion for about two weeks. Then granulations fill in readily and the dressing becomes much less elaborate. Patients are asked to report to the office about twice a week where their progress is watched. It is important to keep the edges of the wound shaved. When epithelization of the wound edges has progressed, a powder dressing with thymol iodide or bismuth-formic-iodide is advised.

By the open method complete healing varies from six to twelve weeks, depending on the size of the wound. After about two weeks there is little discomfort and except for wearing a pad the patient can perform his normal activities.

CONCLUSIONS

1. The nature and etiology of pilonidal sinus is discussed, particularly with reference to its relationship to adolescence.

2. The indications and technic of open operation are described.

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Pain as the result of posterior urethral disease usually is referred to the fossa navicularis or to the penoscrotal angle and is either of a burning or of a lancinating character. . . . Most of those cases in which the sensation is referred to the rectum, however, are in patients presenting some pathology of the sinus pocularis.
From—"Office Urology" by P. S. Pelouze (W. B. Saunders Company).

PRURITUS ANI—AN ALLERGY

ITS DIAGNOSIS AND TREATMENT

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PRURITUS ani should be discussed with constraint and imagination. It is not a specific disease; there is no known specific cause for it and no specific remedy. Like malignancy the problem remains unsolved and therefore its discussion is often controversial.

DIAGNOSIS

Descriptive. Pruritus ani (itching of the anus) is the descriptive name given to a symptom; misnomers are "itching piles," "fissures," "eczema." The diagnosis depends upon the complaint of itching, usually worse at night, supplemented by evidence of perianal skin irritation; this may vary from a mild dermatitis (x) to the most extensive chronic thickening of the skin (xxxx), with abraided, often inflamed areas complicated by varying degrees of infection. The rugae or normal folds may be very much thickened. Pruritus rarely involves the anal canal; it may be found extending entirely around or extending from any part of the anocutaneous margin, more often posteriorly toward the coccyx and/or anteriorly on the perineum. The condition may extend on the scrotum; in women, the dermatitis may also involve both major labia and occasionally the pubis.

Differential. Pruritus ani should not be confused with irritated anal tags nor any of the following conditions that may itch: tickling or a crawling sensation from hypertrophied papillae; fissure, pin worms nor any transient itch of a few days. It must not be confused with trichomonas vaginalis, irritations caused by perspiration—chafing nor hypogonadism as evidenced in pruritus vulvae with extension to the anus.

Out of one hundred patients who present themselves for treatment, 75 per cent should respond to almost any rational palliative care. This accounts for the multiplicity of remedies and "cures" reported. Such usually conscientious reports are based on a fortunate few cases. It is the other 25 per cent that require every consideration; some of these patients are never cured; some develop neuroses through loss of sleep and rest; occasionally one will commit suicide.

Etiologic. Allergy, idiosyncrasy and hypersensitivity are words susceptible of broad interpretation and application with shaded but similar meanings. Their discussion as applied to the perianal region should embrace most of the known etiologic factors of pruritus ani.

Attacks may be induced and continued by a peculiar individual sensitivity to foods, organic matter, such as the secretions of bacteria harbored in anal crypts, fungi (dermatomyces), wool, chemicals as represented by some dyes, synthetics,[1] and drugs. Eczema at the anus may be an allergic response or a specific avitaminosis (B complex).[2] Endocrine imbalance must be thoroughly investigated. As seen during or after the menopause or menstrual cycle, itching suggests a sensitization to some transitory hormone.

Brooke[3] points out that the bacterial theory does not conform to Koch's law, and submits a convincing pathologic study in support of allergy.

I find Andreson's[4] recent discussion of "Allergy Manifestations in the Colon" helpful in the study of pruritus ani. Epitomizing some of his statements: some of the very marked anal and rectal condi-

tions with infiltration, ulceration and bleeding have been found to be allergic in origin; changes showing mild hypersecretion and edema are usually associated with pruritus, and can be traced to an allergic cause. With the history constituting the most important single diagnostic aid, one should look for a family history of allergy, but not necessarily of the same type as exhibited by the patient; recurring illnesses such as asthma, hay fever, migraine, eczema, urticaria, either experienced by the patient, his immediate relatives, his children or ancestors are very suggestive. The onset or cessation of symptoms at puberty or at the menopause, during pregnancy or after some great emotional stress require allergic study. When definite symptoms follow the ingestion of certain foods, such as milk followed by diarrhea, or abdominal cramps after eating mixtures like fruit salads, salad dressing or soups, one or more of such ingredients may be suspected as factors. That situation would be suggestive if pruritus ani were present. In the determination of food allergies in the colon the skin sensitization tests have been practically abandoned; the only real test is the keeping of careful records or repeated trials of a suspected food. That food to which a person is sensitive will always produce symptoms even in small quantities, and if symptoms fail to occur, even after the single ingestion of a food, that particular food may be absolved of blame for previous or subsequent symptoms. Sensitivity to a given food may disappear, and when it does it may be followed by sensitivity to a food previously inocuous; this should be borne in mind when improvement follows the elimination of a certain food, and later there is exacerbation or recurrence.

A serious attempt should be made to discover the sensitizing agents; careful historical inquiry, and a persistent one, may quickly reveal at least one. Grapes in any form, for instance, will induce violent allergic pruritus ani in some individuals which may require weeks to cure; having discovered the sensitizing agent, the secondary infection or dermatitis requires care. Salt, canned fish and shell varieties of sea food may be allergic agents; one must suspect almost any food or drink. Flaxseed (linseed) used by hairdressers has been known to cause pruritus ani to "itch worse"; such patients should disclose a positive scratch or patch test. Karaya[5] marketed as a laxative bulk producer has been found to be an activator. Many other specific instances could be mentioned.

Sensitization or allergic reaction to fungi undoubtedly plays an important role in pruritus ani. The focal infection should be sought as a dermatitis, and may be located on any part of the body. Trichophyton "UFA," Lilly, affords an encouraging means of diagnosis and treatment. If the intradermal test is positive, desensitization with this preparation should be tried.

This localized and persistent itching presents a diagnostic problem, the tentative name of which may well have been "idiopathic" pruritus ani.

PROCEDURE IN TREATMENT

The steps in the treatment are as follows: (1) Story or complaint, (2) physical examination, (3) anorectal and colonic examination; (4) palliative treatment; (5) technical study: (*a*) blood test (Kahn); (*b*) complete count; (*c*) hemoglobin percentage; (*d*) urinalysis; (*e*) patch tests and/or scratch tests, as suspicion warrants; (*f*) search for food allergens; and (6) surgery.

It must be remembered that the patient comes first for relief; this should be secured as far as possible by local applications, sedatives, anodynes and, when necessary, he should be required to stay in bed at home or preferably in a hospital where the complete study may be continued. Then sedation from bromides or barbiturates should be prescribed with added anodynes, ranging from aspirin to morphine as is necessary. The patient must have relief. The local application of equal parts of lime water and sweet oil (carron oil) is excellent. Following rest and the return of poise, 5 per cent—no stronger—silver nitrate solution

should be applied by a cotton applicator. This treatment should result in about 50 per cent improvement. Silver solution may be used successfully every second day until the abrasions are healed, but it should be supplemented by a proved antipruritic or anesthetic ointment.

There are a confusing number of other applications that have proved helpful and often it is desirable to substitute one or more of them. Among these are pure ichthyol warmed for handling, 2 per cent gentian violet, calamine lotion, carbolic vaseline: 1 : 10000 solution of permanganate of potash ($KMnO_4$) as an enema as well as an application.

Vitamins. When one considers the increasing knowledge of avitaminosis as represented by pellagra, scurvy and eczema, a tentative explanation suggests that certain vitamins maintain a normal physiologic balance, the loss of which permits manifestations often called allergy.

A balanced high caloric diet—4500—is supplemented by a standard vitamin (ABCDG) capsule t.i.d. For increased B complex, dry powdered brewers yeast is suggested, about two ounces daily; this may be mixed with six ounces of peanut butter or catsup for palatibility as suggested by T. D. Spies[6] in a succinct discussion of vitamin therapy.

Following the suggested palliative care, marked improvement should have resulted. This is a critical time; a meticulous explanation of the further problem and importance of finding the allergen should be given. And let me urge that the patient and the physician be persuaded to continue the search before masking the symptom—pruritus—by surgery or anesthesia. After reasonable time, however, all anorectal surgical conditions should be operated upon and a subcutaneous perianal neurotomy should close the operation. If surgery is unnecessary and there are no patent crypts, hypertrophied papillae, marked internal hemorrhoids nor anal tags, and if itching is not under reasonable control, one of the several oil soluble anesthetics should be aseptically injected underneath the pruritic area. This is done in two or more stages if the condition is extensive. This procedure should afford relief from the itching for a variable number of weeks. Treatment of the perianal skin should be continued until it is as near normal as is possible, even after it ceases to itch. Pruritic patients should be given instruction as to the nonirritating care of the area, including direction to apply vaseline, cold cream or zinc oxide ointment every night indefinitely.

Technique of Subcutaneous Neurotomy. The entire perianal skin and that lining the canal is undercut through one inch bilateral incisions made outside of the pruritic area, completing first one side then the other. The skin is separated from the subcutaneous tissue with sharp scissors; it may be done principally with the knife. When necessary to undercut the skin of the anal canal, a finger is inserted as a guide. No hesitancy need prevent undercutting as much skin as necessitated by the extent of the pruritus. This severing of the cutaneous nerves is easily accomplished through the two incisions except when the labia and super pubic areas also require neurotomy. The considerable temporary bleeding needs no unusual attention. The nerves do not regenerate for several weeks and no packing nor drainage is necessary. This is strictly an aseptic procedure and no complications need be apprehended. The area will probably be "black and blue" for several days.

COMMENT

Mere knowledge of anorectal and colonic diseases is not sufficient to practice modern proctology. One must be thoroughly trained in surgery, have a reading knowledge of internal medicine and be familiar with allied and contributory conditions.

Diabetic patients are said to complain of pruritus and occasionally this may be true. If such complication does not clear up with proper diabetic treatment, its continuation may be due to an accompanying secondary infection or to a specific allergic response

which may have nothing to do with the diabetes.

Hypothyroidism is occasionally accompanied by a mild pruritus ani, and when suggested by a physical appraisal—low blood pressure, unusual fatigue, dizziness—a metabolism test or a therapeutic test will determine the diagnosis and adequate thyroid administration should follow.

Anthony Bassler,[7] confirming Murray's work on the relation of the Bacillus fecalis to pruritus ani, reports excellent results and gives specific directions for its treatment with vaccine. I believe his results are secured by desensitizing the patient with vaccine. These bacilli are often found when there is no evidence of pruritus ani which supports my conception of allergy. The same deductions may be made when patent crypts are present. In my opinion, they do not cause pruritus ani unless the host is sensitized to some of the bacteria or their secretions which are always present. Kallet reported to me the history of a man who was sensitized to some ingredient in hemorrhoidal suppositories, the patch test being very positive. His local irritation disappeared when the use of these suppositories was discontinued.

Beware of confusing chemical irritation with an allergic reaction. Glycerine suppositories as used in children particularly, cause a sustained local irritation in many of them. A patch test should determine whether it is due to idiosyncrasy or chemical irritation.

Violet ray treatment of pruritus ani is to be condemned since the effect is to aggravate the condition.

Roentgen ray treatment was accurately outlined by Kallet[8] in 1938: "Satisfactory palliation in most instances—." It has its place.

Histaminase is affording interesting development in its relation to allergy.

I prefer perianal neurotomy or the injection of an oil soluble anesthetic to the devastating complications that result from injecting alcohol.

Many treatments have been tried and discarded, while others are still in the experimental stage. Among the latter is the novel procedure of tattooing[9] mercury succinamide or sulphide into the involved skin; this has been suspected of irritating the kidneys. The objective seems comparable to iontophoresis.

CONCLUSION

In representing my conception of pruritus ani, I realize that a complex diagnostic problem is presented. However, if a solution is to be found, advantage must be taken of the modern research in physiology and biology.

Courtesy of The Year Book Publishers, Chicago, from a manuscript in preparation.

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POLYPS OF THE RECTUM*

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A DISCUSSION of this subject seems important for three primary reasons: The incidence of the condition is higher than generally supposed; the marked tendency for these tumors to undergo malignant degeneration is not sufficiently appreciated, and the majority are amenable to office measures of treatment.

A polyp can be defined as any pedunculated or sessile growth projecting into the lumen of the bowel, either the result of hypertrophy or hyperplasia of the mucous membrane, or else as a benign true tumor.

These growths in general may be classified as follows:

A. True benign tumors
1. Lipomas
2. Fibromas
3. Leimyomas
4. Adenomas
5. Angiomas

B. Adenomas
1. Single
2. Multiple

C. Multiple polyposis—also called polypoidosis (Broders)
Multiple polypoid disease (Buie)
1. Congenital type
   a. Adolescent (Erdman) or polyposis universalis (Susman)
2. Acquired type
   a. Adult (Erdman), polypi (Susman)
   b. Postinflammatory—called polyposis cystica intestini (Felsen)

Pseudo-polyposis (Rankin)
Colitis polyposa (Virchow)

As is evidenced from the above outline, the nomenclature within the multiple polyposis group is much confused, many of the different investigators having coined a word which they feel best describes the condition. The congenital type includes those cases usually appearing in adolescent or early adult life in which a strong familial trait is evident, and which gives no history of previous inflammatory or ulcerative disease. The acquired type of multiple polyposis designates those cases which follow extensive inflammatory disease such as ulcerative colitis, bacillary dysentery, amebiasis and tuberculosis of the colon.

The true benign tumors are relatively rare and are listed only because they must be considered in the differential diagnosis of any colonic tumor; otherwise they are outside the scope of this paper.

As suggested in the introduction, the incidence of polyps in the rectum is higher than is generally supposed. Stewart found polyps in 4.19 per cent of 1815 consecutive autopsies, while Susman in a careful search of each specimen, found sixty-five simple or multiple polyps and one case of disseminated polyposis in 1100 autopsies, or an incidence of 6 per cent.

From the clinical side, Buie reported seeing 1234 patients with some type of polypoid disease of the colon at the Mayo Clinic in a ten-year period. This amounted to one patient in thirty-five of those complaining of disturbed bowel function. Of these 86.5 per cent had only one or a few polyps; 9 per cent were associated with chronic ulcerative colitis and 4.5 per cent were of the diffuse congenital type. The average age was about 50 in the solitary group and 31 in the congenital and post inflammatory group. Approximately 70 per cent of all colonic polyps occur in the rectum.

* From the Department of Proctology, Wayne University.

Hypertrophied anal papillae, which may take on a polypoid form, are anal lesions and hence are not included in this discussion. Furthermore, they are not of adenomatous nature.

There are two main schools of thought concerning the origin and development of these tumors. The theory first formulated by Ribbert is the more generally accepted but is losing ground as more evidence becomes available. He was of the opinion that the polyps originated from embryonal cell rests which may remain unaltered or become activated either by local irritation or from constitutional changes. The other view places the main emphasis on local inflammatory causes, but does not exclude some analogue peculiar to the individual.

Gray has reported a well studied case in which allergens were the cause of bowel symptoms in a case of polyposis, as all symptoms were promptly controlled on their removal and periodic barium enema studies showed a gradual disappearance of the polyps themselves.

The observations by Hoelzel and Da Costa on the colons of rats in which they were trying to produce duodenal ulcers by using high roughage diets seem to me of great importance in this question of etiology. They observed varying degrees of polyposis of the colon in 34 per cent of 250 rats. They felt that the intestinal stasis produced by such diets was the main causative factor.

Pathologically, the lesions are adenomatous outgrowths of the mucosa of the colon or rectum into the bowel lumen. They may be sessile or pedunculated, smooth surfaced or papillomatous. The core or stalk is made up of vascular connective tissue covered by thickened mucosa, surrounded by a head which consists of a mass of adenomatous tissue of columnar cell type. The pedicle is produced by the tug of peristaltic action and the effect of the fecal current itself.

Histologically, polyps associated with chronic ulcerative colitis and bacillary dysentery are identical with other types when well developed, but their process of formation has no doubt, been quite different. They represent islands of swollen mucosa or small strips left surrounded by areas of ulceration. As healing takes place these take on definite adenomatous characteristics. It is interesting to note that if these growths do become malignant the grade of malignancy is usually higher than in those of the congenital type.

Several attempts have been made to classify colonic polyps on the basis of their histologic structure with a view to determining those most likely to undergo malignant change. Both Fitzgibbon and Rankin's and Schmieden and Westhues' classifications are worthy of note but the pathologic distinctions in the latter grouping seem more clear cut:

Group I. Polyps the size of a cherry to a walnut; usually solitary; often found in children; pedunculated; rich in stroma and with gland formation. No anaplasia is present. These rarely turn malignant.

Group II. Single; organoid in type; variable in size, but may reach the size of an apple. The stroma is in papillary form. The glands are elongated and irregular, with epithelium showing active proliferation. Anaplasia begins in the center or periphery and spreads laterally. These usually become malignant.

Group III. Variable in size; usually small and multiple; sessile; highly anaplastic and disposed to penetrate into the gut wall. This group always becomes malignant.

Practically, while the tip of a polyp is most likely to be the first site of malignant change, whether or not the pedicle is involved is the most important fact in planning treatment. Clinically, a sessile polyp over 1 cm. in diameter is to be regarded as dangerous.

Manheim and Druckerman's recent report is the only case on record in which one solitary polyp was traced by tissue studies from a benign state to one of definite malignancy. Yet the circumstantial evidence that this is of relatively frequent occurrence is overwhelming. These studies are from two different view points: First, the incidence of carcinoma in polyp cases averages about 30 per cent, varying from 23 per

cent in Susman's series to 45 per cent in Yeoman's; conversely, the incidence of polyps in specimens of carcinoma averages 42 per cent. It would seem only axiomatic from these studies that the greater the number of polyps the greater the likelihood of malignant change.

The symptoms produced by polyps and polyposis vary with the degree of involvement, but are absent or negligible all too frequently. The masses are usually discovered on routine examination. The passage of blood and mucus is the most frequent sign. The blood is usually fresh, with or following stool, and not in large amounts. Diarrhea is the next most important complaint. This is intermittent at first, becoming progressively more severe. Tenesmus is proportional to the proximity to the sphincter and the size of the mass. Pain, if any, is crampy and intermittent unless the polyp has prolapsed outside the sphincter. Nausea is rare except with higher degrees of obstruction. Loss of weight is a late manifestation and is due to diarrhea, obstruction or malignant degeneration. Anemia is proportional to the blood loss. Obstruction is encountered not as frequently from the size of the growth as from the sudden production of intussusception. Several of such cases have been reported. The tumor may prolapse if it is situated low down and has a long pedicle, but recently a prolapsed case was seen in which the pedicle was attached in the sigmoid ten inches from the anal orifice. This tendency for the polyp to prolapse is more common in children in whom the supports of the rectum are weaker and the tissues more elastic.

The diagnosis is usually made by direct examination. The personal history is only suggestive, but the family history is important in the cases of multiple involvement. Digital examination will disclose the low tumors, but if a long pedicle is present it may be mistaken for a hard fecal mass. Sigmoidoscopy will disclose at least 70 per cent of all colonic polypi. Those above the reach of the sigmoidoscope are shown by barium enema *x*-ray, especially when the double contrast method of Weber is used. The larger tumors should be biopsied before deciding on treatment, but the small solitary polyps can usually be removed completely, easily and safely, especially if the tissue is sectioned at once.

TREATMENT

The palliative treatment of colonic polyposis should be used only while preparing the patient for the curative measures or when the latter is contraindicated. The palliative treatment may consist of a high caloric, soft, low residue diet with mineral oil if partial obstruction is present or if it is necessary to keep the fecal material of soft consistency. Any existing anemia should receive attention. Some relief of symptoms has been said to follow the use of enemas of a colloidal suspension of mercuric chloride. Bleeding may be lessened by an enema of acacia, bismuth and adrenalin. *X*-ray and radium therapy have been mainly unsatisfactory. With Gray's experience in mind, allergens may well be searched for and removed when found.

Fulguration through the sigmoidoscope for the 70 per cent of polyps which can be reached by this instrument is the treatment of choice. The growths with a pedicle can be removed easily with little or no danger of hemorrhage with the high frequency snare, using a slow cutting current, while the smaller and sessile growths are effectively destroyed by electrocoagulation. The greatest caution must be used in treating those growths lying above the peritoneal reflection so that the bowel wall is not pierced. In this respect, the high frequency snare and the bipolar electrodes are much safer than unipolar coagulation. The polyps over 3 cm. in diameter with a thick stalk should be removed in the hospital, as frequently a large artery will be encountered in the pedicle which may be hard to control. The other patients may, however, be safely treated in the office with proper equipment. A suction apparatus connected with a long nozzle to remove the smoke and keep the field dry greatly facilitates the work. No anesthetic is necessary or desirable unless it is for sphincteric relaxation

when an unusually large scope is required. Bed rest for the first forty-eight hours is preferable, and no strenuous exercise should be done for ten days.

The single polyps low down in the rectum may be excised with scissors and the base transfixed with a suture. The lesions beyond the reach of the sigmoidoscope require more radical measures and are hence outside the scope of this discussion.

CONCLUSIONS

1. The incidence of single and multiple polyps in the rectum approaches 3 per cent in clinical practice and 5 per cent in autopsy material.

2. All polyps in the rectum are potentially malignant and the probability increases with the number present, approaching 100 per cent in the disseminated types of polyposis.

3. The diagnosis and treatment of the majority of rectal polyps is a safe office procedure with proper equipment.

4. The pedunculated polyps are best removed by the high frequency snare, while the sessile growths should be destroyed by fulguration.

THAT urethral polypi at times produce sensory impulses cannot be denied. The nature of these sensations varies with the location of the polyp pedicle.
From—"Office Urology" by P. S. Pelouze (W. B. Saunders Company).

RUPTURE OF THE BLADDER

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RUPTURE of the bladder is nearly always due to trauma and is favored by vesical distention and pre-existing disease of the bladder wall. The distention is usually from a bladder neck obstruction, a stricture of the urethra or neglect of micturition particularly during drunkenness.

Trauma may be divided into internal and external: The external is due to falls and blows, while internal trauma is usually due to either straining at stool, micturition or parturition. Rupture of the bladder occurs most frequently in adult males, and the posterior superior portion of the vault of the bladder is very often involved because this section is its weakest part.

Rupture of the bladder may be complete or incomplete. In either case, early and speedy operative treatment is imperative. No operative procedure will be of any benefit without free bladder drainage. In incomplete rupture involving only the mucosa and submucous membrane, cystotomy is preferable to catheter in situ because of the danger of pelvic cellulitis which comes on insidiously and which, when evident, is too late to combat.

Rupture of the bladder may be intraperitoneal or extraperitoneal. Both of these types give similar symptoms, except that in the intraperitoneal type we are confronted with a more serious situation presenting the added symptoms of peritonitis. The differential diagnosis of the two is not of much importance since both require immediate surgical intervention.

In the intraperitoneal type of rupture the immediate symptoms are more or less severe shock, pain and a frequent desire to urinate with inability to do so. Frequently a few drops of blood are passed at each attempted micturition. The extravasation of urine may cause rigidity and distention in the region of the bladder. With involvement of the peritoneum signs of free fluid appear in the abdominal cavity. Later symptoms of peritonitis cloud the clinical picture. The severity of the peritonitis depends on whether or not the urine is infected; if infected, the case may terminate fatally from toxemia in a short period of time. If we are dealing with an extraperitoneal rupture, a palpable mass appears within twenty-four hours with more or less pain in the bladder region. A palpable mass in one or both flanks indicates that the urine has dissected its way upward. With infection evidence of sepsis quickly follows.

The mortality rate is rather high. The earlier the diagnosis and operative treatment, the lower the mortality rate. The prognosis is much better if intraperitoneal rupture does not occur. In many instances the diagnosis is not very difficult, but pain in the lower abdomen, tenasmus, bloody urine and difficulty of urination should be sufficient to determine the probable presence of bladder injury.

In many instances rupture of the bladder is associated with injury to the pelvis. Diagnosis is made according to the history of the injury in the bladder region, the presence of shock, the inability to void and the presence of blood in the catheterized specimen.

Radiographic methods of diagnosis are employed but cystocopy is practical and more readily applied. It gives a higher percentage of positive diagnosis. It certainly does not add risk, as some believe, provided, however, that the operation is prompt.

In making a diagnosis by radiographic method, the patient is told to void. If, however, the patient is unable to void, he should be catheterized and the bladder

filled with a 4 per cent sodium iodide or a 5 to 10 per cent hippuran solution. Filling should be stopped when the patient complains of discomfort. If the patient does not complain, it should be stopped at 300 cc. and this amount should be carefully noted. A series of cystograms is then taken, the patient being so placed that the entire bladder outline is shown. The films when developed will show an indistinct picture with extravasated dye outlining the ruptured bladder. If a catheter cannot be passed, a urethrogram should be taken to demonstrate the nature of the urethral injury.

Intravenous urography may also be employed. As a ruptured bladder is suspected or seems probable, skiodan is given intravenously. Five minutes after the injection of the dye, the first picture is taken, and ten minutes later, the second picture. These very often show an extravasation in the region of the rupture. When there is delayed renal function, later pictures are taken at fifteen minute intervals.

For diagnostic purposes simple catheterization without the injection of fluids or air is safer and usually sufficient. The use of a catheter at times may prove a failure with larger tears in the bladder wall. The catheter may drain the peritoneal cavity which may contain a large amount of urine, or then again the constant desire to void and the uncertainty of the amount voided nullifies its purpose to confirm an empty bladder. Where the tear is high and not large, it is possible to inject as much as 300 cc. of fluid and still recover the amount injected. This fact was revealed by one of our cases. In some cases the use of the cystoscope to locate the point of rupture proves fallacious, particularly when there is much bleeding and when the bladder cannot be filled sufficiently because of the size of the tear which offers poor visualization. In some cases fluroscopic observation as a means of diagnosis is useful. Air is introduced through the catheter. With an intraperitoneal rupture the air accumulates at the highest point immediately under the peritoneum when the patient lies on his side. If the patient then sits up, the air is seen to collect under the diaphragm. In extraperitoneal rupture the air spreads perivesically or into the abdominal wall. This method, however, may be dangerous because of spread of infection or air embolism. Contrast cystography may be useful in this procedure: The bladder is filled to a point of discomfort with a four per cent solution of sterile sodium iodide or dilute hippuran or some other dye, with 300 cc. as a maximum. The picture is then taken, the bladder emptied and finally refilled with air for the contrast picture.

Rupture of the bladder is as much a surgical emergency as is an acute condition within the abdomen. Delay is equally dangerous. The diagnosis should be made within a few hours and supportive measures instituted in the meantime.

Surgery consists of suprapubic exploration. When extraperitoneal exposure reveals no extravasation, the peritoneum is opened and a careful search made. The peritoneal surface of the bladder is examined for a tear and to determine the presence or absence of any pre-existing pathology of the bladder wall. A tear can be repaired and the peritoneal opening closed before opening the bladder. However, the rent in the bladder may or may not be sutured. In the author's opinion, it makes no difference either way unless the rent is too large. Of course, the operative procedure depends on the condition of the bladder wall. A diseased wall should be resected and closed tightly, but whatever procedure is employed suprapubic bladder drainage is always indicated.

In vesical rupture a careful history and physical examination are very important and in many cases are sufficient for a positive diagnosis without the aid of *x*-ray or instruments. Symptoms such as suprapubic pain, bloody urine, an empty or nearly empty bladder with abdominal rigidity or free fluid with a palpable mass are usually present.

SUMMARY

In rupture of the bladder, whether complete or incomplete, intraperitoneal or extraperitoneal, the diagnosis should be made within a few hours followed by prompt operative treatment. In many cases a careful history and physical examination are sufficient for the diagnosis. Diagnosis by use of the catheter is generally unreliable; extreme caution should be observed in evaluating findings from its use. The cystoscopic method of diagnosis is most reliable and gives a higher percentage of positive diagnosis. It is preferable to the radiographic methods; in fact, from a practical standpoint, the use of the cystoscope surpasses all other methods of diagnosis.

The earlier diagnosis is made and operative treatment instituted, the lower the mortality rate. The mortality rate is highest in the intraperitoneal rupture, particularly when septic peritonitis supervenes.

Bladder pain varies from the slight discomfort of trigonal congestion to the intense, agonizing pain of acute distention. It may be continuous or intermittent, aching, burning or lancinating.
From—"Office Urology" by P. S. Pelouze (W. B. Saunders Company).

POSTOPERATIVE PAROTITIS*

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IN spite of the many careful studies that have been made on the subject of postoperative parotitis, its etiology is still obscure. Although not particularly common, parotitis is an unpredictable and dangerous postoperative complication and is sufficient in frequency and importance to merit consideration.

INCIDENCE

Studies of the incidence are confusing, as parotitis occurs in general surgery in from one in 800 to one in 10,000 cases. The incidence in general surgery at the Cleveland Clinic was one in 1500 cases. We have found that certain intra-abdominal operations carry with them a higher incidence of parotitis than others. At the Cleveland Clinic Hospital, colon surgery showed an incidence of one in 125, which is comparable with the report of Rankin and Palmer[9] who give an occurrence of one in 135 cases of colon surgery. Over half of the cases of parotitis in our series occurred following colon surgery, 65 per cent of these cases complicating the postoperative course of patients having abdominoperineal resections of the rectum, making the incidence in that procedure one in twenty.

ETIOLOGY

Since parotitis was first described in 1834, several theories for its etiology have been presented. Among these are:

1. Sympathetic—a relationship between the parotid gland and the generative organs.

2. Heat degeneration—hyperpyrexia causing a breakdown of gland substance.

3. Toxin excretion theory—failure to excrete the toxins present in the gland during a generalized disease.

4. Lymphatic—a possible cause, but presupposes an infection in the parotid area.

5. Traumatic—caused by trauma over the gland.

6. Abdominal reflex—based upon the fact that the action of the gustatory nerve is inhibited when a loop of intestine is drawn from the abdominal cavity.

7. Hematogenous—a theory widely held today, that postoperative parotitis is due to a septic thrombus.

8. Ductogenous or ascending—a direct extension of organisms from the mouth.

Modern opinion favors the ductogenous theory. Although there is no reason that hematogenous infection should not occur, it is difficult to produce indisputable clinical and bacteriologic evidence that such is the case.

Studies were undertaken to confirm the findings of those who stated that the terminal third of Stenson's duct normally contains organisms which are predominately staphylococci. Smears and cultures of the parotid ducts and the alveolar border opposite the orifice of the duct were taken in twenty-five normal individuals. Staphylococci were present in the majority of cases; the culture was sterile in only one-half of the cases. In order to determine the effect of poor oral hygiene on the concentration of staphylococci in Stenson's duct, ten patients who were considered to have foul mouths were subjected to the same procedure. Both smears and cultures showed that the ducts contained about twice the number of staphylococci and that the cultures were sterile in only a third of the cases.

Cultures were taken from the mouths of individuals before and after operations and severe illnesses. The staphylococci present only in small numbers before operation

* From the Cleveland Clinic.

became more numerous after operation. When the mouth did not become dry and when proper postoperative oral hygiene was given, the organisms did not increase in number. An interesting fact was that the sublingual region contained only a few such organisms. This, perhaps, can be attributed to two factors: (1) the incessant motion of the tongue keeping the area clean, and (2) the fact that the submaxillary gland contains mucin in its secretion, a substance which has been proved by Seifert[11] to be a bactericidal agent both in vitro and in vivo.

Wolbach and Bessey[12] have shown that vitamin A deficiency causes atrophy of the epithelial lining cells of many of the epithelial structures, including the salivary glands, genitourinary tract, respiratory tract and the eyes. Following atrophy, proliferation of basal cells was seen which produced stratified epithelium of keratinized cells in place of the normal columnar epithelium. Such metaplasia often would result in the accumulation of desquamated cells in the acini and ducts of the various organs and would tend to occlude the ducts. Since Stenson's duct normally contains bacteria, it was logical to presume that in the presence of epithilial changes and possible occlusion and stasis, infection might easily occur and parotitis might quickly follow. Therefore, a group of cases with colon disease was studied to determine whether or not a deficiency of vitamin A might be a factor in the production of the high incidence of parotitis in these cases.

Twenty-two patients having carcinoma of the colon were tested for dark adaptation by the Frohring apparatus. Sixteen had a reading which showed a definite deficiency of vitamin A. Postoperative parotitis developed in five of the sixteen patients, and postoperative pneumonia developed in three. In the six cases having normal biophotometer tests, the only complication that occurred was a single case of pneumonia. Although this experience is too small to allow us to draw any conclusions, we are continuing to study all cases subjected to colon surgery and to test them for vitamin A deficiency.

REVIEW OF SIXTY CASES OF PAROTITIS

The average age of the sixty patients who developed postoperative parotitis was 50½ years. The sex was evenly divided and the season of the year seemed to play no part. The parotitis was first observed between the first and the eighteenth postoperative day, the time of onset of the average case being on the fifth postoperative day. The side involved was not significant, for a third were bilateral and in the remaining two-thirds each side was involved in an equal number of cases. A careful survey of the general condition of the patient indicated that forty of the sixty were in good condition, eight in fair condition and twelve in poor condition.

The duration of the operation played no part in the development of parotitis.

Anesthesia was considered as a possible factor, but over half of the cases had spinal anesthesia and the remainder had a combination of local and nitrous oxide or ether and nitrous oxide anesthesia. Atropine was given in only twenty of the sixty cases.

In this series of cases, dehydration rarely occurred; the patients usually received adequate amounts of fluid parenterally. However, many patients were not allowed fluid by mouth until the second or third day and did not have the best possible postoperative oral hygiene or oral hydration. Parotid stimulation by forceful mastication, as by chewing gum, was not insisted upon immediately after operation.

High urea estimations existed in nearly every case of parotitis and incision and drainage of the gland often was accompanied by a recession of the level of blood urea. We believe, however, that the urea retention is associated with the toxemia and dehydration, and is more often the result than the cause of the parotitis.

It is interesting to note that pain over the temporomandibular joint upon opening the jaw was the earliest complaint of the majority of the patients with postoperative

parotitis; swelling first appeared six to eight hours later.

In summary, the chief factors in the production of postoperative parotitis are: (1) Oral sepsis and inadequate dental prophylaxis; (2) inhibition of salivation; (3) dehydration; (4) absence of mastication and failure of the attendants to provide proper postoperative oral hygiene; (5) vitamin A deficiency resulting in an alteration of the epithelium and a lowering of its resistance to infection; and (6) a peculiar tendency for parotitis to occur following colon surgery.

MORTALITY

A review of the literature reveals widely differing mortality rates. Mortality rates are given on the basis of gross mortality in some series, as well as on actual mortality from the complication itself. In our series there were fifteen deaths, three definitely caused by parotitis, two in which parotitis was a definite contributory factor, and ten in which parotitis played only a small rôle in the death of the patient. Although death from parotitis alone is rare, we believe that parotitis contributes to death when it is the chief factor responsible for the terminal depression. The mortality is increased markedly if incision and drainage is necessary, whereas prompt and adequate treatment, particularly deep roentgen therapy, seems to reduce the mortality. Incision and drainage was performed in twenty-three cases, with a mortality rate of 43 per cent; thirty-seven patients were treated without operation, with a mortality rate of 11 per cent.

TREATMENT

In postoperative parotitis, as in any other condition in which the actual causative factor is unknown, treatment has been variable and a multitude of therapeutic measures have been advocated. Treatment includes three essential points: preoperative preparation, postoperative care and active treatment if the complication develops.

Prophylaxis includes hydration, oral cleanliness and the assurance of no existing vitamin A deficiency. The fluid intake of the patient should be maintained at a normal level. Transfusion, particularly in an individual with carcinoma, often is of value. Careful and thorough dental prophylaxis is usually indicated. The preoperative medication should be designed to avoid general depression and depression of salivation. General vitamin therapy should be given in all cases of colon disease. Since vitamin A deficiency is considered to be a possible factor in the production of parotitis and if a known deficiency of this vitamin exists, large amounts of vitamin A should be given prior to operation.

Postoperative care should include hydration, oral hygiene and stimulation of salivation. Stimulation of salivation by simple chewing is one of the most important prophylactic measures because such mechanical cleansing of the duct obviates bacterial stasis. Chewing of gum should begin within the first twenty-four hours after operation. Although the use of lemon candy may stimulate salivation, we do not believe that its prophylactic value is equal to that of forceful mastication. Vitamin therapy should be given parenterally until the patient is able to take vitamins by mouth. Vitamin A, while not yet generally available for parenteral injection, should be given as soon as possible.

Because it is impossible to determine whether or not the parotitis will subside or will suppurate, at first it is necessary to treat all active cases alike. Once postoperative parotitis is known to be present, the following measures should be instituted immediately:

1. *Active Mastication.* The patient must be urged to chew gum. Although pain exists, chewing must continue.
2. *General Supportive Measures.*
3. *Sulfathiazol.* This drug favorably influences the course of staphylococcal infections and has been of value in several cases of parotitis in which it has been used.
4. *Roentgen or Radium Therapy.* Radium has been used by some and is of value, but in our opinion roentgen therapy is the treatment of choice if given imme-

diately after the determination of the presence of postoperative parotitis. The value of roentgen therapy is diminished if given after the first few hours of the onset of the complication. Treatment may be given with any portable machine whose output is known, and requires application for only a few minutes. Generally only 200 to 400 r units are required, giving approximately one-half skin erythema dose, but it is not harmful to give as much as five treatments each of 200 r units over a period of ten days. The value of roentgen therapy is increased because of its ready availability, its rapidity of application and the ease of proper control and concentration.

5. *Incision and Drainage.* If roentgen therapy has failed and if the patient has not shown clinical improvement, it occasionally is necessary to incise and drain the gland. Most cases should be observed for from five to six days before surgical intervention. The incision need not be large, as adequate drainage can be obtained through a small incision if the capsule of the gland is broken and the abscess drained.

SUMMARY

1. Postoperative parotitis is a frequent and important complication of colon surgery.

2. Death from parotitis alone is rare but the additional burden of this complication may be the factor precipitating an unfavorable end result.

3. The majority of infections probably are ductogenous in origin, and the responsible organism is the staphylococcus.

4. It is logical to regard the presence of postoperative parotitis as evidence of decreased resistance to organisms frequently present in the mouth.

5. Vitamin A deficiency with attendant atrophy of the epithelial cells of Stenson's duct may be responsible for the lowered resistance of the parotid gland. Occlusion of the duct secondary to salivary stasis is possible because of the accumulation of keratinized cells produced during the process of metaplasia.

6. Staphylococci exist normally at the terminal third of Stenson's duct. Oral hygiene seems to govern the concentration of such organisms.

7. The biophotometer test indicates the presence or absence of sufficient vitamin A in the system. If a vitamin A deficiency is shown to exist, it should be corrected.

8. Preoperative care should include hydration and oral hygiene.

9. Postoperative prophylaxis should consist of continuance of oral hygiene, hydration and the institution of active mastication as soon as possible.

10. Treatment after parotitis has developed should include roentgen therapy applied immediately, regardless of the hour or the condition of the patient. Sulfathiazol, whose action against the staphylococcus might prevent bacteremia, should be given.

11. Incision and drainage usually is not required.

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FRACTURES OF THE NASAL BONES*

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THE great importance of the proper treatment of nasal fractures, both from the cosmetic and functional standpoints, is all too frequently underestimated by the attending physician as well as by the patient himself. This neglect is apparently due to a lack of realization of the handicap produced by nasal disfigurement and the fact that the edema of the adjacent soft parts hides the displacement of the fragments.

An undesirable deformity becomes a matter of considerable economic and social as well as psychologic importance to the patient, especially when the economic and social competition of today is considered. The patient may become "appearance conscious" and refrain from all social activity. It therefore is imperative that fractures of the nasal bones receive immediate care. At this time their correction is relatively simple. Once the deformity has become well established, it can be remedied only by a difficult plastic operation.

Particularly to be condemned is the neglect of a fractured nose in a child, as any correction of a neglected deformity must wait until the nose has reached its full growth, which is approximately at the seventeenth year. In the meantime, the child must tolerate the discomfort of nasal obstruction and its sequelae, as well as the frank comments of his associates.

The management of simple fractures has not changed appreciably in the past few years.

Anatomic Considerations. The nasal bones are two quadrilateral, not triangular, bones which form the upper half of the bridge of the nose. They articulate above with the frontal bones, medially with each other, the perpendicular plate of the ethmoid and cartilaginous septum, laterally with the nasal processes of the maxillae, and below with the upper lateral cartilages. Any injury causing fracture of the nasal bones is almost certain to affect some of the adjacent structures.

CLASSIFICATION OF NASAL FRACTURES

Almost all nasal fractures may be grouped as either the median or the lateral type. In the median type, the blow generally is struck in the midline directly from in front. The type of fracture will vary with the nature of the blow:

1. If moderate, the fragile inferior edge of the nasal bone may be fractured.

2. If the blow is somewhat higher, the nasofrontal articulation may be separated and the inner bony arch may be displaced and impacted. Because the nasal spine itself is supported posteriorly by the vertical plate of the ethmoid, there is a continuity of bone from the bridge to the crista galli which explains why a blow on the nose can force the perpendicular or the cribiform plate of the ethmoid upward into the anterior cranial fossa. This is more true with increasing age since the articulations become firmly ossified to form one solid mass of bone which at times transmits the force of a blow from one end to the other.

3. The force of the blow may be great enough to cause comminution of the nasal bones and flattening of the entire arch. The bony septum again is subjected to considerable trauma. At the same time, the nasal processes of the maxillary bones may be depressed. In this type of fracture, a definite ridge can be felt at each side of the nose.

In the lateral type of fracture, a blow to the side of the nose may fracture only one nasal bone, resulting in depression of that side of the nose, or the entire bony arch may be separated from its attachment at the base as well as from the nasofrontal

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suture and may be deviated to one side. In this type of fracture a depression of the nasal bone and possibly of the adjacent part of the maxillary bone is found on the side the blow was struck, and the opposite bone will be displaced toward the other side. An attempt to push the opposite bone inward should not be made until the depressed bone or bones are elevated and replaced.

Injury to the lateral cartilages or to the cartilaginous septum may occur independently or in connection with bony fractures. Dislocation of these cartilages often leads to nasal obstruction or to external nasal deformity. These conditions resist immediate treatment, and often require a secondary operation for their correction.

Fractures of the nasal bones frequently are compound; that is, the bones protrude through the skin, the mucous membrane or both. Infection, however, usually fails to develop, but if the patient blows his nose, occasionally the rent in the mucous membrane allows the development of a subcutaneous emphysema with its characteristic crackling sensation on palpation in the tissues about the nose, eyes and lower forehead.

The Nasal Septum. The tearing of the septal cartilage at some of its attachments may be evident as a marked dislocation immediately after the injury, or no change may be seen until long after the injury when a ridge caused by inflammatory thickening is found along the previously loosened border. The septum may be dislocated from its attachment to the superior maxilla and may deviate in one nostril or the other. The most common dislocation occurs at the function of the cartilage of the septum with the vomer and the ethmoid.

Fractures usually occur in the posterior two-thirds of the cartilaginous septum and in the anterior half of the bony septum. Fractures of the nasal bones with little displacement may produce no change in the septum. Even with considerable depression and comminution of the nasal bones the septum may appear to be unchanged, although there may be bowing or tearing at the seat of the fracture.

Fractures of the septum sometimes are classified as horizontal or vertical. A horizontal fracture is the most common and produces a groove-like deformity roughly paralleling the floor of the nose. A convexity appears in one naris and a concavity in the other. A vertical fracture may occur anywhere in the course of the cartilaginous septum; but when it is situated well back, it must be distinguished from dislocation of the cartilage.

SYMPTOMS AND SIGNS

1. Pain usually is not marked, but if present, it is caused by congestion of the mucous membrane of the nose, combined with blockage of drainage from the various sinuses.

2. Epistaxis occurs frequently and is caused by the rupture of the delicate nasal mucous membrane by the bony fragments. It may be unilateral or bilateral. It may be slight and cease spontaneously, or it may be severe enough to exsanguinate the patient unless arrested.

3. Nasal obstruction may result either from the accumulation of blood in the nasal passages or from the fracture or dislocation of the septum with swelling of the mucous membrane. Occasionally, a hematoma of the septum will produce obstruction.

4. Ecchymosis is due to the subcutaneous extravasation of blood and usually appears within a few hours after the injury. It is most marked in the eyelids and may be severe enough to close the eye. The severity of the hemorrhage and swelling usually increases for forty-eight hours and then subsides. Almost all of the discoloration disappears within two weeks.

5. Bony crepitus usually can be elicited by digital manipulation of the nose. Its absence, however, does not signify that a fracture is not present.

6. The presence of emphysema generally is definite evidence of involvement of one of the nasal sinuses. However, blowing the

nose may force air beneath the skin through a tear in the mucosa.

7. External deformity is not apparent unless the nose has been deviated from the midline or has been crushed inward, depending on whether or not the blow was from the midline or from the side. Slight deformity frequently is masked by the swelling and ecchymosis and may easily be overlooked.

8. Internal deformity in the nose includes (1) deviation, dislocation or fracture of the septum and (2) obstruction of the air space on one or both sides by swelling of the mucous membrane, hematoma of the septum or compression of the bony framework.

DIAGNOSIS

The diagnosis can be made from the history, symptoms and signs, except in cases in which the fracture is very mild and when edema or swelling of the soft tissues is slight and no external deformity is apparent. Frequently a mild case in which there is ecchymosis of the orbit is falsely ascribed to simple contusion of the soft parts. However, in such instances there always is localized tenderness on pressure combined with the other symptoms of nasal fracture.

Roentgenograms always should be taken. They usually will show the location of the fracture and the amount of dislocation of the fragments. At times, however, a fracture in this region will be missed by the roentgen rays. This is because the nasal bones show well on only the lateral view. The postero-anterior view shows them very poorly. Because of this roentgenograms cannot be relied upon as much as in fractures of other bones. If the fracture and displacement do show, a recheck roentgenogram should be taken after the bones have been set.

GENERAL MANAGEMENT

From a medicolegal standpoint, it is well to establish the presence or absence of external nasal deformity, nasal obstruction and the condition of the sense of smell prior to the injury.

If the trauma is sustained in an automobile injury or on a farm, the advisability of administering tetanus antitoxin must not be overlooked.

It must be remembered that a satisfactory reduction cannot be obtained without anesthesia. The injection of novacaine along each nasolabial fold, plus intranasal packs of cocaine and adrenalin, usually will suffice except for children or hypersensitive adults. In such cases, one of the general anesthetics should be given.

The skin is cleansed thoroughly with soap and water and all dirt and foreign bodies are removed. Any effective present-day germicide may be used. Debridement should be conservative in respect to viable bone, cartilage or skin. Small fragments of bone never should be removed, as they seldom sequestrate and greatly aid the healing process. Lacerations should be sutured meticulously, subcuticular suturing being preferred.

Repositioning of the fragments is a simple matter of applied mechanics. Deviations of the entire nasal bridge or lateral spreading of the nasal bones can be corrected by external pressure with the thumbs. Depressions of the nasal bones may be elevated with almost any blunt instrument that can be inserted into the nostril. A nasal elevator is preferable. A slight degree of overcorrection must be maintained to allow for a tendency to recurrence. In depressed fractures, a quarter inch vaseline gauze pack forced upward between the septum and lateral wall on either or both sides will stabilize the fragments. This packing may remain a day or two, after which it is removed or replaced. Occasionally the fragments will be impacted sufficiently to remain in proper position.

In lateral deviations and outward displacements some type of external splint is needed for stabilization. A bandage roll held against either side of the nose by adhesive tape, or a splint molded from dental compound, plaster of Paris or soft metal is satisfactory. For difficult lateral

deviations, a head band appliance may be necessary to exert sufficient lateral pressure.

If the lateral cartilages have been torn loose from the lower margins of the nasal bones or the maxillae, they must be replaced. If a deformity of the septum is present, it will improve greatly following elevation of the depressed nasal bridge. The gauze packing used for maintaining elevation of the nasal bones also will aid in maintaining the septum in the midline, but septal fractures are difficult to maintain in proper position as the cartilaginous septum unites only by fibrous union. If a deformity of the septum does persist, it can be corrected later by a submucous resection.

Fair union begins in about one week, while firm union may be expected in three to four weeks. The older the deformity, after the first four or five days, the more difficult it is to correct, and the greater is the force necessary to separate the fibro-osseous union. The skin dressings are continued for as long as necessary.

COMPLICATIONS

Infection of the external or internal wounds may produce abscesses. Softening or necrosis of bone or cartilage may develop following hematoma or abscess. This may produce secondary deformities resulting from the contraction of the tissues. The most marked example of these is the saddle-back nose. Emphysema may be noticed if the fracture opens into the nasal cavity. The lacrimal duct may be obstructed if the nasal processes of the maxillae are involved. The nasal bone may be forced up into the floor of the anterior fossa of the skull and intracranial complications may arise. Osteomyelitis, chondritis, erysipelas, cellulitis, periostitis or perichondritis may be late complications.

SUMMARY

The importance of careful attention to all injuries in the middle third of the face is obvious since fractures can readily be disguised by edema of the soft tissues.

Improper treatment may result in the development of unsightly deformities which will impose a mental, social and economic handicap on the patient.

Painstaking repositioning of fragments is necessary and slight overcorrection of the deformity is required to obtain a satisfactory end result. Some form of immobilization must be employed in many instances to prevent a recurrence of the deformity.

Each case should have a detailed analysis of individual structures and not just a diagnosis of fracture of the nose.

SEBACEOUS, MUCOUS, DERMOID AND EPIDERMOID CYSTS*

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COMPARED to many types of neoplasms affecting the body, sebaceous, epidermoid, inclusion dermoid and mucous cysts are relatively unimportant. However, since the majority of such tumors occur about the head and neck where they are unsightly or at least conspicuous, there is always a demand for the removal of such growths by surgical procedures which leave a minimal amount of residual scarring. While some individuals apparently are unconcerned over such tumors unless they are associated with an active inflammatory process, there is an increasing number of people who seek medical advice about such growths because of the fear that they may be of a malignant nature. Aside from the patient's viewpoint, the removal of all such cysts is to be recommended because many are likely to become acutely infected and suppurate for a lengthy period of time and because in rare instances one will undergo a malignant change.

Mucous cysts, which are lined with cuboidal or columnar epithelium and contain a mucoid material, offer no diagnostic uncertainties on microscopic examination. However, many cysts of the sebaceous, epidermoid and dermoid varieties are difficult to distinguish because their histologic structure may be very similar and because there is no uniformity among pathologists as to the exact characteristics of these tumors. Broders and Wilson have found that practically all so-called sebaceous cysts which are lined with stratified squamous epithelium do not contain the fatty, sebaceous and odorous material typical of a sebaceous gland but contain layer upon layer of nonfatty, odorless (unless infected) keratin. They, therefore, prefer to call these keratin filled tumors "keratomas." (Fig. 1.) A true inclusion dermoid cyst, which develops along the embryonic clefts and lines of fusion, is lined with stratified epithelium which possesses sebaceous and sweat glands and hair follicles; the cheesy material in such a growth is of a sebaceous character. In the stratified epithelial lining membrane of an epidermoid cyst, no hair follicles or sebaceous or sweat glands are evident although the cystic contents are sebaceous in nature. The majority of epidermoid cysts are congenital and develop in situations corresponding with those of inclusion dermoids. The former, therefore, are probably inclusion dermoid cysts rather than sebaceous cysts; certainly, they are not keratomas. Confusion is added to this conception of epidermoid cysts since many pathologists consider all sebaceous cysts and keratomas as epidermoid tumors. For the sake of clarity I prefer to recognize those cystic skin tumors whose contents consist of keratin as "keratomas," and those which are of acquired origin and which contain sebaceous material as "sebaceous cysts." I consider "inclusion dermoids" to be congenital cysts developing along the embryonic lines of fusion and containing hair follicles and sweat and sebaceous glands in their walls. "Epidermoids" are similar in nature to dermoid cysts with the exception that their linings possess none of the previously mentioned dermal structures.

Although keratomas and sebaceous cysts may arise in the subcutaneous tissues of any part of the body, the majority occur in the scalp and in the lobe and on the posterior surface of the ear. In these regions they are frequently multiple. Such tumors

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are usually rounded, firm, and though freely moveable are invariably attached to the skin at one point, a feature which often distinguishes them from dermoid and epidermoid cysts. In the skin overlying many keratomas and sebaceous cysts, there is visible an enlarged pore from which cheesy material can be expressed on manipulation of the growth. There is a wide degree of variability in the dimensions of these tumors; some are minute, scarcely visible nodules, while others attain a diameter of several centimeters. Inconstant also is the thickness of their walls, which is largely dependent upon the width of the fibrous capsule surrounding them. Those situated in the scalp are usually heavily encapsulated, while those about the face and ears often possess an extremely thin fibrous covering.

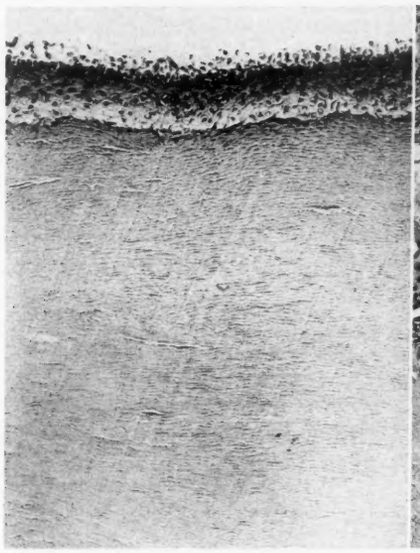

Fig. 1. Keratoma; the lining membrane of stratified squamous epithelium is apparent as well as the countless layers of keratin within the cavity of the cyst (× 130).

Fig. 2. Keratoma containing a grade 1 squamous cell epithelioma; the penetration of malignant tissue into the keratin content of the cyst is visible (× 130).

Keratomas and sebaceous cysts, ordinarily symptomless, are frequently the site of an acute inflammatory process in which the tumor becomes excessively tender and painful, and objectively suffers a sudden increase in size. Such an inflammatory condition may not necessarily be the result of bacterial invasion but may be due entirely to trauma as would occur from squeezing or from a blow. If such be the case, no pus is produced, and within the course of a few days the inflammatory process undergoes complete resolution. More commonly, however, bacterial infection is the etiologic basis for the inflammation. Much purulent material is then formed within the cavity of the cyst, which eventually ruptures and discharges its contents. When acutely infected, the cyst resembles an acute abscess and exhibits all of the general and local symptoms which attend such a process. Following an acute infection, a keratoma or sebaceous cyst may resume its normal proportions and appearance. Occasionally, the infection completely destroys the epithelial lining and with subsequent healing the entire cavity of the growth is obliterated. Under such circumstances, the tumor disappears altogether and is replaced by scar tissue. Unfortunately, an acute infection in one of these tumors often becomes chronic. The causative organisms remain in the walls of the cysts and incite the production of purulent material which is continually discharged externally through a sinus.

Such suppuration, when long continued, produces marked excoriation of the surrounding skin. Naturally, acute exacerbations of chronic infection are common. When chronically infected, a sebaceous cyst or keratoma becomes surrounded by dense fibrocicatricial tissue which may completely mask the true nature of the lesion.

FIG. 3. Large dermoid cyst of the floor of the mouth, pushing the tongue up to the palate and producing much interference with articulation, mastication and deglutition.

Much care should be exercised in removing keratomas and sebaceous cysts. If, while extirpating such a tumor, a remnant of its lining is left within the wound, the growth will promptly recur. Consequently, the old method of transfixing a sebaceous cyst, expelling its contents, and pulling away its lining membrane is usually unsatisfactory especially when the cyst is not heavily encapsulated. By such a procedure, a thin-walled cyst tears readily and its complete removal is seldom accomplished.

It is preferable to excise a keratoma or sebaceous cyst through a skin incision, which should be made cautiously to avoid nicking the wall of the underlying cyst. Moreover, when the growth is situated on the face, the direction of the line of incision should follow the normal furrows of the skin, which greatly decreases the conspicuousness of the ultimate scar. After incising the skin, two small hooks employed to retract the cut edges give an excellent exposure of the top surface of the tumor. Then, by careful blunt dissection, using a curved forceps or dissecting scissors, the entire growth can be shelled out intact. Although painstaking, this technic rarely results in tearing of the wall of the cyst and assures its complete removal. Should there be present a sinus or pore from which the contents of the growth can be expressed, it is well to include a segment of skin surrounding this sinus in the initial incision. Havens has described a method of injecting procaine hydrochloride for local anesthesia between the skin and wall of the cyst which renders the line of cleavage edematous and, in turn, facilitates dissection. He said that "the needle [of the syringe] is inserted at a point near the apex of the tumor (near the base if the skin over the apex is very thin) with the bevel of the needle turned toward the tumor and its shaft nearly parallel to the surface of the skin. It should be inserted slowly and at the same time a little pressure should be applied to the plunger of the syringe. The aim is to advance the needle only until its tip is just under the skin. Usually, it is easy to tell when this point has been reached by the lessened resistance to the progress of the needle and also by the fact that the solution readily enters the tissues. When properly inserted, the tip of the needle is in the line of cleavage between the capsule of the cyst and the surrounding tissues. The solution when injected at this point follows the line of cleavage completely around the tumor and usually provides perfect anesthesia."

Small, extremely thin-walled cysts which occur commonly about the ears and face are often difficult to eradicate by the foregoing method of dissection. In these cases, removal is simplified by sharply excising a block of tissue surrounding and including the cyst.

Following excision of a keratoma or sebaceous cyst, the skin edges should be approximated and neatly sutured with a fine suture material. Of more importance, however, is the care of the cavity created by removal of the tumor. Blood and serum

should be prevented from collecting in such a cavity by establishing complete hemostasis and by attempting to collapse its walls. Obliteration of the cavity may be effected by means of subcutaneous catgut sutures in small wounds and by the use of an external pressure dressing in those of large dimensions. Such care is particularly important after the dissection of a large cyst in the anterior part of the scalp. Should a hematoma develop here, it is likely to migrate downward infiltrating the tissues of the forehead and eyelids, a serious complication if the hematoma becomes infected. In addition to pressure over large wounds, it is advisable to insert a drain for forty-eight hours; rubber bands make most effective drains and leave an insignificant opening on removal.

Excision of these tumors when acutely inflamed is strictly contraindicated. However, under local anesthesia produced by a spray of ethyl chloride they may be incised and their contents expelled. This relieves the local symptoms and hastens resolution of the inflammatory process. As previously stated, an acute infection in one of these cysts may completely destroy its lining; healing of the wound may follow with permanent disappearance of the growth. But in the event that the cyst recurs, excision should be postponed until three or four weeks have elapsed following the active inflammatory process.

Chronically infected cysts become surrounded by such a dense layer of fibrocicatricial tissue that any line of cleavage which may have been present about the tumor is entirely destroyed. Consequently, their removal necessitates sharp dissection followed by ample drainage of the wound. If the cyst is situated on the cheek, sharp dissection should be undertaken with much caution for fear of injuring some of the fibers of the facial nerve or perhaps even the parotid duct. Particularly troublesome are chronically infected cysts on the posterior surface of the neck; even after their complete excision, chronic suppuration from the dense scar tissue of the wound may persist. In such cases, in preference to excision, therapy should consist of exposure of the cystic cavity followed by thorough destruction of its lining and the surrounding tissues with surgical diathermy. The wound should then be packed widely open with iodoform gauze until healed.

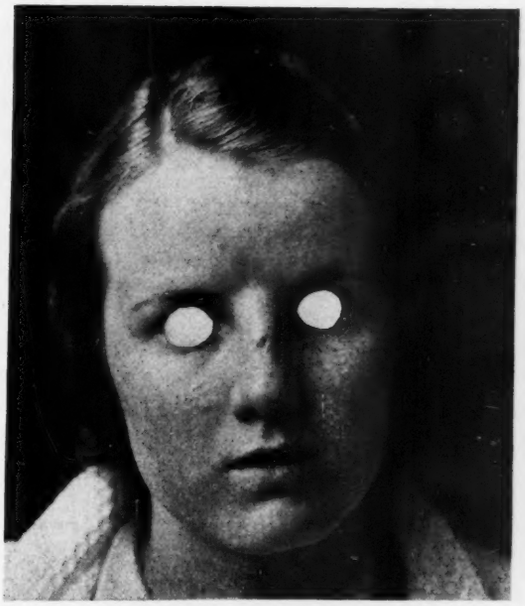

FIG. 4. Inclusion dermoid cyst of the bridge of the nose with an external sinus. This growth had been noticed since the patient's birth, was attached to the underlying periosteum, and possessed a tract of dermoid tissue extending between the nasal bones. Removal was effected by excision of the tumor together with the attached periosteum. The deep sinus tract was destroyed with surgical diathermy.

One cannot sufficiently emphasize the importance of examining microscopically every keratoma and sebaceous cyst which is removed. Although of rare occurrence, malignant changes definitely do develop in the epithelial lining of these tumors. At the Mayo Clinic, we have encountered several squamous cell epitheliomas in keratomas. (Fig. 2.) In one instance, I removed such a growth which revealed histologically a grade 2 squamous cell epithelioma which had perforated the capsule of the cyst; in this case, it was necessary to electrocoagulate the operative site thoroughly after operation. Sebaceous cysts developing in basal cell epitheliomas are not to be

confused with malignant changes in a keratoma or sebaceous cyst.

A mucous cyst represents a true retention cyst in which the orifice of a mucous gland becomes obstructed, forcing the mucus subsequently secreted to accumulate within the lumen of the gland. Mucous cysts are most frequently encountered about the lips and within the mouth. Frequently, they discharge their contents spontaneously, and this process is followed by refilling of the cyst with mucus. As in the case of keratomas and sebaceous cysts, mucous cysts may become acutely infected. The removal of mucous cysts by excision is comparatively simple unless they are situated in inaccessible recesses of the oral cavity. Under such circumstances, they can be easily destroyed with surgical diathermy.

Inclusion dermoids and epidermoids are simple, congenital cysts, which develop along the lines of embryonic fusion as the midventral and middorsal lines and the branchial clefts. Inclusion dermoids are not to be confused with congenital dermoid cysts of teratoma type, which arise from embryonic germinal epithelium. Occurring usually in the ovaries and testes, teratoma dermoids possess a thick wall which contains elements derived from any one or all three of the germinal layers. Well-developed structures such as nails, teeth, brain and glandular tissues are frequently encountered in these cystic teratomas. Acquired implantation dermoid cysts also are to be distinguished from congenital inclusion dermoids. The former type represents merely an inclusion cyst that develops as a result of trauma; a portion of skin is carried into the deeper structures of the wound where the dermal cells form a cyst lined with squamous epithelium. Implantation cysts occur most commonly on the hands but occasionally on other exposed parts of the body.

Practically all inclusion dermoid cysts are found about the head and neck. On analysis by New and the writer of 103 dermoids of the head and neck, 49.5 per cent involved the oribital regions and eyelids, 23.3 per cent of the floor of the mouth, 12.6 per cent the nose and 14.6 per cent the median line of the lips and median line of the occipital, frontal and cervical regions. Dermoid cysts are prone to develop in these locations because they are the fusion sites of various embryonic structures. Moreover, it is not surprising that a greater percentage of these cysts occurs in the orbital region than elsewhere when one considers the complexity of the embryonic development of the eyes and lids.

Inclusion dermoid cysts, which may vary in size from a few millimeters to several centimeters, are rounded growths, situated in the subcutaneous tissues and are but rarely attached to the overlying skin. Their congenital nature is evidenced by the fact that a large percentage of these tumors are apparent at or shortly after birth. While the smaller ones are usually firm, those of larger dimensions have a characteristic doughy feeling. In a few, a sense of fluctuation can be elicited. Many of these growths possess a sinus from which sebaceous material can be expressed and from which hairs may be found to protrude. On removing many dermoid cysts, especially those about the orbits and frontal region, a crater-like depression in the underlying bone is found. In an occasional case, cord-like extensions into the surrounding soft and bony tissues are discovered. Inclusion dermoid cysts may be distinguished from keratomas and sebaceous cysts by their situation, their congenital nature and by the fact that they are seldom attached to the overlying skin. These characteristics are suggestive; a doughy feeling is characteristic, and the protrusion of hairs from a sinus of the cyst is diagnostic of a dermoid.

Dermoid cysts involving the floor of the mouth, submental or submaxillary regions, may be, when small, palpable but symptomless. However, they have a marked tendency to increase ultimately in size either in the course of their natural growth or

through infection. When reaching large proportions, they often push the tongue up against the palate, causing difficulty in articulation, mastication and deglutition. (Fig. 3.) Fortunately, dysphagia and dyspnea are rarely encountered, but when present are at times serious. Since the treatment of dermoids involving the floor of the mouth, submental and submaxillary regions certainly does not come within the realm of office surgery, methods for their removal will not be discussed in this paper.

Dermoid and epidermoid cysts in other sites may be excised in a manner similar to that described for keratomas and sebaceous cysts. However, dermoids are inclined to be fixed to the surrounding tissues which makes their removal by blunt dissection often impossible. On the contrary, sharp excision is frequently essential. When an external sinus is present, the initial incision should include an elliptic portion of skin around the sinus, which facilitates removal of the tract. It is important to bear in mind that cord-like extensions from any dermoid cyst may be present; these should be dissected away from the adjacent tissues if a cure is to be expected. When adherent to bone, the periosteal attachment must be removed along with the tumor.

In many dermoid cysts involving the bridge of the nose (Fig. 4), extirpation is met with difficulties inasmuch as such growths not only are frequently attached securely to the underlying periosteum but also may possess a sinus tract of dermoid tissue that extends down between the nasal bones into the septum. If one removes the surrounding bone in an attempt to excise such a tract, the procedure may result in considerable deformity of the nose. When excision is inadvisable, the tract often may be removed by light electrocoagulation with surgical diathermy, a current of insufficient strength to cause sequestration of the adjacent bone being employed.

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EMERGENCY TREATMENT OF HEAD INJURIES IN THE ACCIDENT DISPENSARY*

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THE increase in head injuries caused by automobile accidents has placed a definite responsibility upon the shoulders of the intern in the accident dispensary. He sees the patients when they are at their worst. They are often in shock and the cerebral symptoms are complicated and masked by injuries elsewhere or by alcoholism. The intern's judgment and treatment frequently decide the fate of the individual. If careless, he may permit the premature discharge of a subdural or epidural hemorrhage suspect. Broken bones, especially fractures of the spine and internal injuries, may be missed in the unconscious patient if they are not thought of and looked for. The stuporous patient having an alcoholic odor may be erroneously labeled "another drunk" and so indicted on the chart from a medical and legal sense, when he may actually have a skull fracture and perhaps may have had only an innocuous glass of beer.

In a teaching institution or a hospital where a resident staff is present, the intern has the advantage of an immediate consultation with the residents in the various specialties if problems in diagnosis or treatment occur. However, in the majority of hospitals in this country the intern must handle the emergency himself, at least for the first hour or two until his chief arrives.

The following plan of emergency treatment of head injuries is taught by Professor Temple Fay and associates to the senior students of Temple University School of Medicine and is followed by the interns on duty in the accident dispensary of the hospital. In addition, the intern is required to fill in a brief but pertinent form which is a valuable record for the intern who receives the case. This form becomes part of the hospital record or the dispensary record if the patient is not admitted.

OUTLINE FOR EMERGENCY TREATMENT OF HEAD INJURIES IN THE ACCIDENT DISPENSARY

A. Treat Shock First.

1. Patient flat. Do not lower head.
2. *Apply heat* until rectal temperature is 99 degrees or above. *Careful of burns.*
3. If hemorrhage from scalp wound is present, control it temporarily by packing wound with *dichloramine "T" 1 per cent or alcohol pack* and *fairly tight bandage.* Arterial bleeding is controlled by hemostats and the vessels ligated *after patient reacts from shock.*
4. Give adults *50 cc. of 50 per cent glucose* intravenously stat.

   Children are given one-half to one-third this dose. If volume of pulse is poor and rate is 120 or over and there is no marked improvement within 10 minutes after glucose injection, give *normal saline slowly intravenously* (60 drops per minute and about eight ounces or 240 cc. every hour) until pulse rate drops below 120 and systolic blood pressure rises to 90 or above and diastolic pressure to above 60. May repeat glucose in one-half hour if no improvement.
5. If excessive perspiration is present, prevent further depletion of blood volume by subcutaneous in-

* From Temple University School of Medicine.

jection of 15 minims of *surgical pituitrin* every one-half hour and *atropine sulfate* gr. 1/100 subcutaneously every hour until blood pressure has reached level as given above in (4).

6. If loss of blood is excessive, have patient and available donors typed and crossed while infusion is given and *transfuse if necessary*.

7. Make sure that patient has an *adequate airway*, that the tongue does not fall back and that no foreign bodies or dental plates are left in the mouth. Be careful when applying metal mouth gags. A broken or loosened tooth may be aspirated into the lungs.

8. If the patient is unconscious, 10 per cent carbon dioxide in 90 per cent oxygen may be given intranasally by two small catheters attached to a glass "Y" tube.

B. *While above Treatment Is Progressing, Examine Patient for*

1. Fractured bones (suspect a fracture of spine, especially in cervical region until proven otherwise).

2. Injury to ribs (subcutaneous emphysema, hemo- and pneumothorax).

3. Abdominal, renal and pelvic injury or hemorrhage.

4. *Do not move or turn patient during shock.*

(a) If long bone is fractured, apply temporary splint without manipulation. If compounded, call resident or chief.

(b) If chest, abdominal or pelvic injury is suspected, call resident or chief immediately.

(c) If cervical fracture is suspected, support head and neck with sand bags on either side. Call resident or chief.

C. *When Patient Reacts from Shock* (usually 15 minutes to one hour after onset of treatment). Rectal temperature rises to 99 degrees or above; systolic pressure to 90 or above, and diastolic to 60 or above.

1. *Do a careful neurologic examination:*

(a) Inspect ears, nose, mouth and throat for evidence of bleeding or cerebrospinal leak and the sclera for subconjunctivial hemorrhage (basilar fracture?).

(b) Decide whether patient is aphasic or unconscious by strong pressure over supraorbital nerves. If patient endeavors to remove examiner's hands from painful area, he is not unconscious. Facial muscles will grimace on side of painful stimulus if patient is not unconscious.

(c) Note size and shape of pupils and reaction light. A fixed, dilated pupil or a progressively dilating pupil on one side suggests an expanding epi- or subdural clot, fluid or edema on that side.

(d) Examine cranial nerves (see b).

(e) Test patient's ability to use extremities. Check for weakness or paralysis. External rotation of the entire lower extremity when not voluntary is caused by a fracture of the femur or paralysis of the extremity. If patient is unconscious, raise both upper extremities above the head and permit them to drop to bedside. The paretic or paralyzed extremity drops in a flaccid "rag doll" manner.

(f) Test the deep tendon reflexes and for the Hoffman and Babinski sign.

(g) Note the reaction of the patient to painful stimuli applied to each side of the body.

(h) Check patient now for possible fracture of spine. Do

not move patient from table until satisfied that no obvious fracture of spine, especially in cervical region, is present. If cervical fracture is suspected, apply chin-occiput harness with steady traction before moving. If fracture of other vertebrae are suspected, avoid flexion and extension movements in transporting patient. Do not move patient unless you have enough help to lift him properly.

D. If Neurological Examination Shows

1. Cerebral involvement as evidenced by any of the following: prolonged unconsciousness (one-half hour or more since the accident), aphasia, definite pupillary changes, psychotic or peculiar actions, weakness or paralysis of the extremities, sensory changes, the *patient should be admitted and sent directly to room or ward.*

2. If patient's general condition is good, laceration, if present, can be sutured in accident dispensary. If it is extensive or condition poor, cleanse, secure hemostasis, pack, delay suturing and admit patient to house (see treatment of laceration).

E. If Patient Has Reacted from Shock, Is Conscious, and Neurologic and Physical Findings Are Negative and There Is Still Doubt as to Cerebral Injury

1. Do lumbar puncture (see technique and contraindications below). Record pressure and take off 1 to 3 cc. of fluid to determine whether clear or bloody. If spinal fluid is pink or cherry red in color and homogeneous throughout, subarachnoid hemorrhage is present and is evidence of laceration of the pia and a probable skull fracture.* Patient should be admitted.

2. If spinal fluid is clear and pressure is above 12 mm. of mercury, or 160 mm. of water under correct technic, patient should be admitted to dispensary bed and observed for possible subdural or epidural clot.

3. If spinal fluid is clear and pressure below 12 mm. of mercury, laceration of scalp should be sutured if present. Patient should then be kept in accident ward for observation for at least two hours and then discharged if feeling well, with instructions to report to family physician or if clinic patient to report to accident dispensary if severe headache, vomiting or any unusual symptoms occur. Patient should not be discharged from dispensary unless accompanied by friend, relative or police, who can escort patient home where he can be watched for any untoward symptoms.

F. Method of Examining and Repairing Laceration of Scalp.

1. Cut and then shave all hair within a radius of at least two inches from any point of the laceration. In a woman so arrange the hair and comb it so that later the uncut part can be combed over the cut area.

2. Cleanse shaved area thoroughly with soap and water, avoiding the laceration or its edges at this stage.

3. Apply three and one-half per cent iodine to cleansed area and remove with alcohol.

4. Put on sterile gloves and completely surround peripheral border of shaved area with a one per cent novocaine block so that the novocaine ring is one inch internal to the hair border. (Fig. 1.)

5. The laceration will now be anesthetic and can be cleaned, inspected and sutured without pain to the patient.

6. Inspect wound for foreign bodies. All dirt and grease should be removed from margins or depth of

* Routine spinal punctures were done on every patient in over 600 cases of head trauma treated on the Neurological-Neurosurgical service. Seventy-five per cent of patients having bloody spinal fluid subsequently had a proven skull fracture.

wound by cotton applicators soaked in benzine. The laceration is then gently irrigated and sponged with ether followed by three and one-half per cent tincture of iodine. (*Caution:* Protect patient's eyes against irrigating solutions.)

7. Change gloves and proceed to inspect wound for injury to bone, herniations of brain tissue, cerebrospinal leak. Use sterile gloved finger to palpate carefully and gently for depressions. Use no probes (these may introduce infection to deeper levels). If inspection or palpation or both suggest a *compound fracture of the skull,* gently pack laceration with dressing of one per cent dichloramine "T" or alcohol and *admit patient to the hospital.* Never suture a laceration in a suspected compound fracture of the skull except in an operating room where the set-up will permit handling of any difficulties or complications that may occur when bone fragments are manipulated or the brain exposed.

8. If there is no evidence that the periosteum has been torn and the bone injured or exposed (in other words if there is no compound fracture), the laceration should be sutured with silk or wire. All traumatized and necrotic tissue should be debrided carefully, saving as much normal tissue as possible. Venous and capillary ooze will be controlled by pressure on edges of laceration and when the sutures are tied.

If the galea is cut, this layer should be approximated with interrupted sutures placed about one-fourth to one-half inch apart and tied firmly with just enough pressure to approximate the edges without strangling them. The skin and subcutaneous layer down to the aponeurosis can then be sutured as a separate layer. The sutures should be placed about one-half inch apart, should enter and emerge from the skin at least one-fourth inch on each side of the lacerated edge. They should be tied

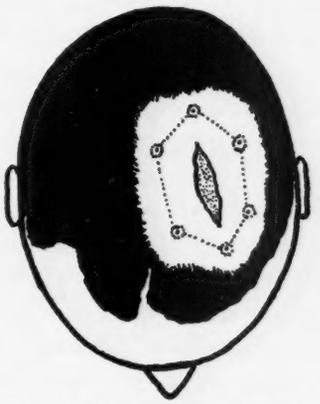

FIG. 1. Preparation of scalp before repair. The scalp is shaved and cleansed with soap and water; followed by application of three and one-half per cent iodine which is removed with alcohol. The laceration is not touched. The wound is then surrounded by a ring of one per cent novocaine which is placed about one inch internal to the periphery of the shaven area. The laceration and its edges are now anesthetic and can be cleansed, inspected and sutured without pain.

just firmly enough to approximate the edges and should lie flat without puckering or creasing the skin.

It is not necessary to drain if the wound has been cleansed thoroughly and appeared clean initially. If the wound was dirty or if a great deal of tissue was contused, insert a rubber dam drain from one-fourth to one-half inch in width in one angle of the laceration before the sutures are tied, so that the inserted end will be under the aponeurotic layer if it was cut, or down to the aponeurosis if only the skin and subcutaneous tissues were involved. The sutures may then be tied.

An alcohol dressing should then be applied to the sutured area and kept in place by a head dressing. (Be

careful not to make head dressing too tight or headache will develop.)

Patient should report in twenty-four hours to family physician or clinic for removal of drain or inspection of wound. Sutures are removed on the fifth day.

9. All dirty or punctured wounds or those received in fields, farms, or about premises where horses or cattle are present, should receive a prophylactic injection of tetanus and gas gangrene antitoxin.

10. Wounds of forehead are treated like those in hair areas except that the deep and subcutaneous layers do not tolerate silk, therefore, No. 000 chromic gut should be used for these deep layers. The skin and subcutaneous layer should be sutured with either interrupted or continuous dural silk and a vaseline gauze dressing applied. No drains are used. The sutures should be removed on the fourth day if healing occurs. These precautions are used to reduce the size of scars.

G. Treatment of Alcoholic with Suspected Head Injury

1. Treat the same as any head injury case.

2. Do not give depressant drugs.

3. Do not do lumbar puncture and drainage until out of shock.

4. If noisy and uncooperative, patient may be given paraldehyde, drams 1 to 3 by nasal tube.

H. Pointers in Doing Lumbar Puncture

1. Do not flex head but permit it to be kept in natural position. Flexing head may constrict jugular veins and increase intracerebral venous and hence cerebral spinal fluid pressure as much as 20 mm. Hg. and thus give a false high reading.

2. Never do lumbar puncture in sitting position. Patient to be on his side in horizontal position.

3. Never do lumbar puncture without manometer and initial pressure reading.

I. Contraindications to Lumbar Puncture

1. Pimples, acne, or infection in or about lumbar puncture area (third or fourth lumbar interspace).

2. Shock.

3. Uncooperative patient.

4. Irregular respirations or (respirations below 16)—suggest medullary compression. Call chief resident or resident on neurosurgery before doing puncture.

If fractured spine is suspected, patient is not to be moved from table until chief resident physician, resident on orthopedics or resident on neurosurgery examines the patient.

DISPENSARY RECORDS IN CASES OF HEAD INJURY

Most of the patients have received their injuries in automobile accidents, fights when at work and at times when inebriated. These cases are, therefore, often of medicolegal importance. Accurate records in the dispensary are vital to the patient's interest as well as to others involved and certainly to the intern on the ward who receives the case. Too often the records say "drunk" or under the "influence of alcohol." It is the duty of the intern to record on the records that there is an odor of alcohol if he definitely smells it. He should not state that the person is drunk or under the influence of liquor unless the patient is awake, boisterous, loquacious and exhibits the classical actions seen in the active, acute, alcoholic spree.

Since the intern is extremely busy in the accident dispensary, it is essential that the records he must make be brief and to the point. The following form was arranged and is used in the Temple University Hospital Accident Dispensary:

TEMPLE UNIVERSITY HOSPITAL

ACCIDENT DISPENSARY HEAD INJURY RECORD

FILL IN THIS FORM AND SEND WITH PATIENT IF ADMITTED

Name: Color: Age: Sex:

Date: Time: (1) Admitted to dispensary: Brought in by:
(2) Discharged from dispensary:
(3) Sent to ward or room:

History: (1) Where found and etiology of accident:

(2) Condition of patient on entering dispensary with initial TPR:

(3) Final TPR and blood pressure when sent to ward or discharged from dispensary:

Examination:

(1) Location and extent of scalp injury:

(2) Comparative size of pupils and reaction light:

(3) Bleeding or cerebrospinal fluid from cavities of skull:

(4) Abnormal neurologic findings:

(5) List fractures of bones:

(6) List suspected injury to chest, abdomen, kidney, bladder or spine:

(7) List evidence of alcohol odor to breath:

Treatment: Name and amount of drugs and antitoxin given and record of TPR and blood pressure q. ½ hour:

Lumbar puncture done? If so, give (a) Initial pressure—
(b) Amount and color—
(c) Final pressure—

Record treatment of scalp laceration if present:

Signed:

INTERNAL DRAINAGE OF THE GALLBLADDER*

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FOR the past twenty years, whenever practicable, we have used internal gallbladder drainage, that is, turning the infected organ into the stomach or duodenum, as a routine procedure. It is the main object of this paper to report the results of 300 such operations during that twenty-year period.

GENERAL CONSIDERATIONS

The gallbladder today probably occupies more space in our medical journals than any other single surgical subject. This overwhelming mass of literature, which periodically breaks out like a rash, indicates that, among those who should be authorities, there is little agreement concerning the best time for operation on the inflamed gallbladder; and that the type of operation which best meets the various lesions is far from a settled problem in the surgical mind.

From the mass of often contradictory statements certain points stand out—a dawning realization that gallbladder disease is but a part of a general biliary tract infection involving the whole biliary tree, ducts, liver and frequently the pancreas; that regarding the acute gallbladder opinion is sharply divided as to the advisability of immediate or delayed operation; that in the chronic gallbladder operation is indicated where the organ is acting as a primary pyogenic focus, where there is cholecystic indigestion and colic with *x*-ray evidence of stones, and where gallbladder symptoms without *x*-ray evidence of stones are not relieved after three months' medical treatment and duodenal gallbladder drainage; that the acute case relieved by medical treatment and duodenal gallbladder drainage is not surgical; but that the patient long treated medically, without relief, usually receives prompt benefit from surgery; and that cholecystectomy is today the operation of choice.

CHOLECYSTECTOMY

Arguments for Cholecystectomy. The operation is the complete removal of what, it is hoped, is the etiologic toxic focus. It is a beautiful operation and appeals to the esthetic taste of the skilled surgeon.

Arguments against Cholecystectomy. It is a major operation with a relatively high mortality in unskilled hands. Serious postoperative complications may occur. One surgeon reports it as a cause of common duct stricture in seventy-three of eighty cases in which he operated.[1] Removal of the gallbladder does not relieve symptoms in a high percentage of cases. Results published in the 1938 *Year Book of Surgery*,[2] may be quoted as a fair estimate. Following cholecystectomy the mortality given is 7.8 per cent in 5,705 operations, as reported from the personal and collected cases of six authors. Persistent symptoms of bilary indigestion occurred in 52 per cent of 668 cases reported by three authors. Persistent symptoms of biliary colic occurred in 20 per cent of 442 cases reported by two authors. There was a surprising inconsistency in the percentage of cures as reported by different surgeons. Such figures would indicate that cholecystectomy is far from a completely satisfactory operation.

* From the Surgical Service, Temple University School of Medicine.
Presented before the New York Chapter of the National Gastroenterological Association, November 20, 1939.

CHOLECYSTOSTOMY

Arguments for Cholecystostomy. It can be done successfully and has a lower mortality in the hands of the less experienced surgeon. It drains, for a limited time, what may be an infection of the whole biliary tree. It is permanently successful in at least 80 per cent of cases.[1]

Arguments against Cholecystostomy. Following external drainage we have a recurrence of cholecystitis or a reformation of gallstones in from 15 to 20 per cent of cases.[1]

INTERNAL DRAINAGE
CHOLECYSTODUODENOSTOMY OR CHOLECYSTOGASTROSTOMY

Arguments for Internal Drainage. It maintains continuous drainage of an infected gallbladder or an infected biliary tree. It is a minor intra-abdominal operation with a comparatively low mortality. As a last resort, following unsuccessful cholecystectomy, anastomosis of the common bile duct and duodenum is the accepted surgical procedure.

Arguments against Internal Drainage. Animal experiments have demonstrated that following cholecystenterostomy there is an infection of the gallbladder with ascending infection of the biliary tree; and that the fistulous opening closes if the common duct has not been ligated. In the human subject spontaneous rupture of the gallbladder into the stomach or intestinal tract, with formation of a biliary fistula, is frequently followed by symptoms of ascending biliary duct infection.[19]

External gallbladder drainage demonstrates the outstanding facts: that the bile from an infected gallbladder changes from a dirty, tarry or purulent fluid to normal straw colored bile in about four days; that it continues coming through the gallbladder as normal bile as long as drainage is maintained; and that toxic symptoms and colic subside as the bile clears and flows freely. It would seem that if such a flow of normal bile could be continuously maintained through the gallbladder into the digestive tract, without reverse infection of the biliary tree or closure of the fistula, the ideal operation is attained.

Postoperative Cholangeitis in Animal Experiments. Seventy-five cholecystenterostomies done by five operators and reported by three authors[3,4,5] gave results as follows: The dogs were killed from three months to one year after operation. There was laboratory evidence of infection of the gallbladder, bile ducts or liver in all except three dogs. There were no frank liver or bile duct abscesses. No mention was made of the general health of the dogs; presumably it was good. Is it not possible that these low grade microscopic infections in the dog without general health impairment have been given an undue importance in their application to the human subject? And that every individual with a chronic cholecystitis has for years had such a microbic infection of his biliary tree until it acutely localizes in a poorly draining gallbladder? The relief afforded by duodenal tube gallbladder drainage would support the theory.

Postoperative Cholangeitis in Man. Operators of considerable experience state that in the human subject the danger of liver infection is slight. In 279 cases reported by four authors,[6,7,8,9] there was but one case of suppurative cholangeitis. In this case the operation was done for obstructive jaundice from carcinoma of the pancreas. I have collected six cases of death from cholangeitis, including one unreported case of my own, which may be summarized as follows:

1. Obstructive jaundice, carcinoma of the pancreas.
   Death three months postoperative.[3]
2. Obstructive jaundice, carcinoma of the pancreas.
   Death seven months postoperative.[8]
3. Obstructive jaundice, chronic pancreatitis.
   Death four months later.[10]
4. Obstructive jaundice, carcinoma of the pancreas.
   Death nine months later.[10]

5. Gallbladder colic for twelve years. Operations during this period were: cholecystostomy, cholecystectomy, choledochoduodenostomy and finally end-to-end suture of the common duct. Patient died twenty-four hours after the last operation of acute cardiac dilatation. Autopsy showed general systemic atheroma with chronic hepatitis.[11]

6. Author's case: The initial operation was a cholecystoduodenostomy for stones. No stone was palpable in the common duct. The patient was in good health and symptom-free for three years. She had intermittent gall stone colic with fever and jaundice for six months before the second operation. The stools were normal in color during the jaundice attacks. At the second operation (Dr. W. W. Babcock) a stone was found in the common duct surrounded by putrid pus. The liver showed tawny areas suggestive of fatty degeneration. The duodenal stoma was open.

Cholecystectomy was done, with closure of the anastomosis and common duct drainage. Postoperatively, hemorrhage, fecal fistula, subphrenic abscess, and empyema occurred, death resulting from general septicemia seven weeks after operation. No autopsy was permitted.

Summarizing the six cases, the first four followed the usual course of common duct obstruction from pancreatic tumor with or without operation. Cholangeitis has more frequently developed spontaneously in duct obstruction from tumor of the head of the pancreas than following a planned cholecystenterostomy.[3,7,12] The fifth case, one of chronic hepatitis following anastomosis of the common duct to the duodenum appears to have been one of a general body sclerosis. The author's case was a true suppurative cholangeitis apparently due to unrecognized common duct stone at the time of the original operation. It is possible that removal of this stone with bile duct drainage might have averted the ultimate catastrophe. These six cases indicate that symptomatic cholangeitis following routine internal gallbladder drainage is very rare.

Closure of the Biliary Fistula in Animal Experiments. The report of three research workers[4,13,14] on dogs, is that if the common duct is not ligated, the flow of bile is not diverted from the common duct and the biliary fistula tends to close. But one must remember that in dogs we have a presumably healthy biliary tract, not the infected biliary tree of the human subject who presents himself for a gallbladder operation.

Closure of the Biliary Fistula in the Human Subject. I have not found recorded any evidence of secondary abdominal operation where a previously made biliary fistula was examined. It is my privilege to report findings in eight cases, seven of which I personally explored during the past nineteen years.

Case I. Cholecystoduodenostomy was done in a female, 24 years old, who had a strawberry gallbladder. She had no biliary symptoms for two months. Posterior gastroenterostomy was done eight months later for a gastric ulcer. The patient is living and has no biliary symptoms nineteen years later.

Case II. Cholecystoduodenostomy was done in a female, 44 years old because of gallstones. Operation four years later for an incarcerated hernia in an old low abdominal scar showed a prolapsed leather bottle stomach. Death occurred from progressive asthenia three weeks later.

Case III. Cholecystoduodenostomy in a female of 42 was followed four years later by operation for pyloric obstruction from a thickened contracted pyloric muscle. Posterior gastroenterostomy was done. Death occurred from myocarditis three years later.

Case IV. Cholecystogastrostomy was carried out in a 48 year old female who had cholecystitis with jaundice. Exploratory operation five years later for intermittent hiccough showed adhesions with angulation of the transverse colon to the scar. The adhesions were freed and no recurrence of jaundice took place during fifteen years. The hiccough recurs, but this is probably psychic.

Case V. Cholecystoduodenostomy in a female, 45 years old, for gallstones, was followed four and one-half years later by operation for recurrent epigastric distress and a large keloid in the abdominal scar. No intra-abdominal pathology was found. The patient died of peritonitis seven days later. Autopsy showed no cause for the peritonitis. There was no leakage or sign of infection about the exploratory incision in the gallbladder.

CASE VI. Cholecystogastrostomy was done in a female, 50 years old, who had gallstones. A second operation was done three years later for an obstructive band at the ileocecal region. Two years later the patient was living, and had no gallbladder symptoms.

CASE VII. Cholecystogastrostomy for cholelithiasis in a female, 61 years old, was followed by exploratory operation three and one-half years later for an inoperable cancer of the descending colon.

CASE VIII. Same as the fifth case mentioned under postoperative cholangeitis.[11] Here a functional patulous fistula was noted.

The exploratory findings about the anastomosis were practically identical in the first seven cases. The adhesions in all except Case VIII were not marked nor comparable in density to many I have remarked in opening the abdomen following a cholecystectomy. The gallbladder in each case was contracted, with its surface vascularized, and looked more like intestine than gallbladder. It was from $\frac{3}{8}$ to $\frac{1}{2}$ inch in diameter, and its walls averaged $\frac{1}{8}$ inch in thickness. The mucosa was soft. Inside was a patulous duct, about $\frac{1}{4}$ inch in diameter, slightly contracted at the fistulous opening. A grooved director could be freely passed into the cystic duct and into the duodenum or stomach. It contained straw-colored liver bile. The liver, by inspection, showed no evidence of hepatitis.

The results in these eight cases indicate that, in the human subject with an infected biliary tree, the fistula does not close if the common duct is not ligated, and the gallbladder resolves itself into an accessory functional bile duct carrying healthy bile.

CHOLECYSTODUODENOSTOMY OR CHOLECYSTOGASTROSTOMY

From the Standpoint of Infection. Bacteriologists state that the intestinal bacteria increase from the duodenum down to the sigmoid, and that the colon bacillus is the chief offender in biliary tract infections. The colon bacillus is less common in the duodenum and stomach than in the distal digestive tube. The general bacterial count is higher in the stomach than in the duodenum, but colon bacilli and streptococci are uncommon in the stomach and frequent in the duodenum. The gastric juice exerts a destructive influence on bacteria.[17]

From the Standpoint of Surgical Technique. Because of its mobility and the thickness of its walls, stomach anastomosis is more easily done and is apt to give a less permeable suture line. Bile in the stomach does not disturb gastric processes.[18] Most operators have preferred the duodenum as it most nearly restores normal physiologic relations. However, the duodenum must frequently be mobilized before an anastomosis without tension can be made and every extra intra-abdominal incision adds to the danger of infection in an already contaminated area. Our last series of 100 cases, without mortality, have all been stomach anastomoses. We have come to feel that the stomach fistula is preferable because it is an easier operation, is less traumatic, and bacterial studies indicate that there should be less danger of retrograde infection.

OPERATIVE TECHNIQUE

Open the abdomen under combined spinal and local anesthesia. When necessary, free the distal end of the gallbladder from the under surface of the liver sufficiently to allow the fundus to lie against the point of anastomosis without tension or kinking. Do a classical end-to-side anastomosis with a stoma $\frac{1}{2}$ to $\frac{3}{4}$ inch long. (Fig. 1.) With a distended gallbladder the anastomosis can often be done without liver separation. This is the ideal operation as it opens fewer portals for infection. A small cigarette safety drain is left in place for forty-eight hours.

STATISTICS

In two previous articles I have reported results in 200 cholecystenterostomies.[13,14] I now add another 100 cases done during the past nine years.

In the whole group of 300 cases, all of which had combined spinal and local anesthesia, 130 were duodenal anastomoses and 170 stomach anastomoses. In 66 per cent stones were present. Of the group, 88 per cent were women, and the average age was 45 years, with the youngest 18 and the oldest, 72. The total postoperative mortality was 3 per cent. Causes of death were: epidemic flu, one; one following administration of intravenous glucose (before the day of proper glucose standardization); four deaths, 1.33 per cent, the direct result of the operation.

In the last 100 cases, all were cholecystogastrostomies and there was no postoperative mortality. This flattering result was probably due to more careful preoperative and postoperative care in which rest, intravenous glucose guarded by insulin, and saline hypodermoclysis were the main factors. In the bad risk or where suppuration or extensive gangrene existed, a simple cholecystostomy was done. This follows the accepted principle of abscess drainage in other body areas. A secondary cholecystogastrostomy was done in four cases in this series where symptoms of cholecystic indigestion recurred after spontaneous closure of the external fistula. All four were relieved following the second operation.

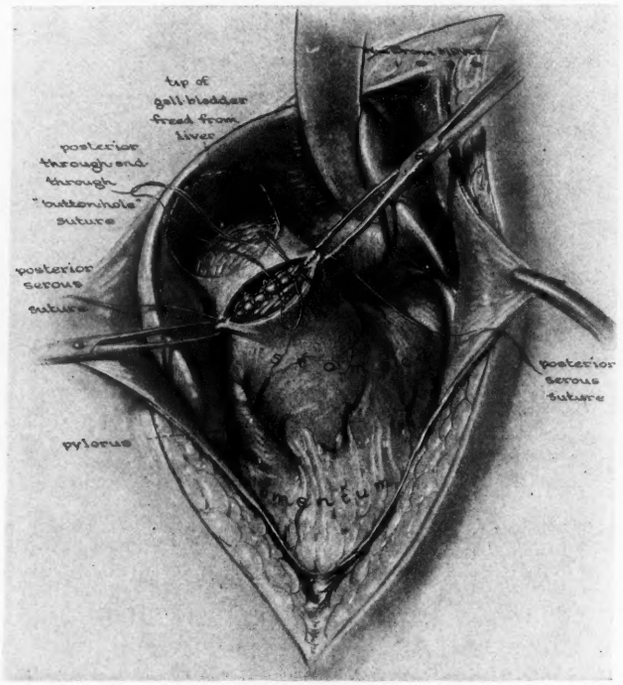

FIG. 1. Technic of cholecystogastrostomy. The gallbladder is mobilized by partial freeing from its liver attachment. A typical end into side anastomosis is made by a fine linen serous stitch and No. 00 chromic gut through and through buttonhole stitch. In the distended gallbladder, freeing from the under surface of the liver is unnecessary.

Follow-up in 100 Consecutive Cases. Operation in this group was done from three to twenty years ago, and records were obtained from patients or their families. They were questioned in regard to recurrent jaundice, gallstone colic or cholecystic indigestion.

Recurrent jaundice occurred in but one case (mentioned under "postoperative cholangeitis"). A common duct stone produced symptoms three years after operation.

True gallstone colic occurred in the one case just mentioned. Three others gave an identical history of symptomatic stone: pain without jaundice, lasting from one-half to three hours, occurring three or four

times each year and ceasing suddenly without medication. One can visualize in these cases a contracted stoma and an acutely distending gallbladder, with sudden relief as the dilating bladder forced open the stoma and the bile again escaped through the safety valve into the digestive tube.

Cholecystic indigestion was a difficult point to decide honestly. In this day of overeating and under-exercising, most middle aged subjects have some gas and complain of it. We accept the definition of cholecystic indigestion as a qualitative dyspepsia, with fullness after eating and distress in the epigastrium or under the ensiform, accompanied by sour, bitter eructations, belching and occasional vomiting. In this series fifty-four patients claimed perfect digestion after normal eating. Thirty had some symptoms, less severe than before operation, and were

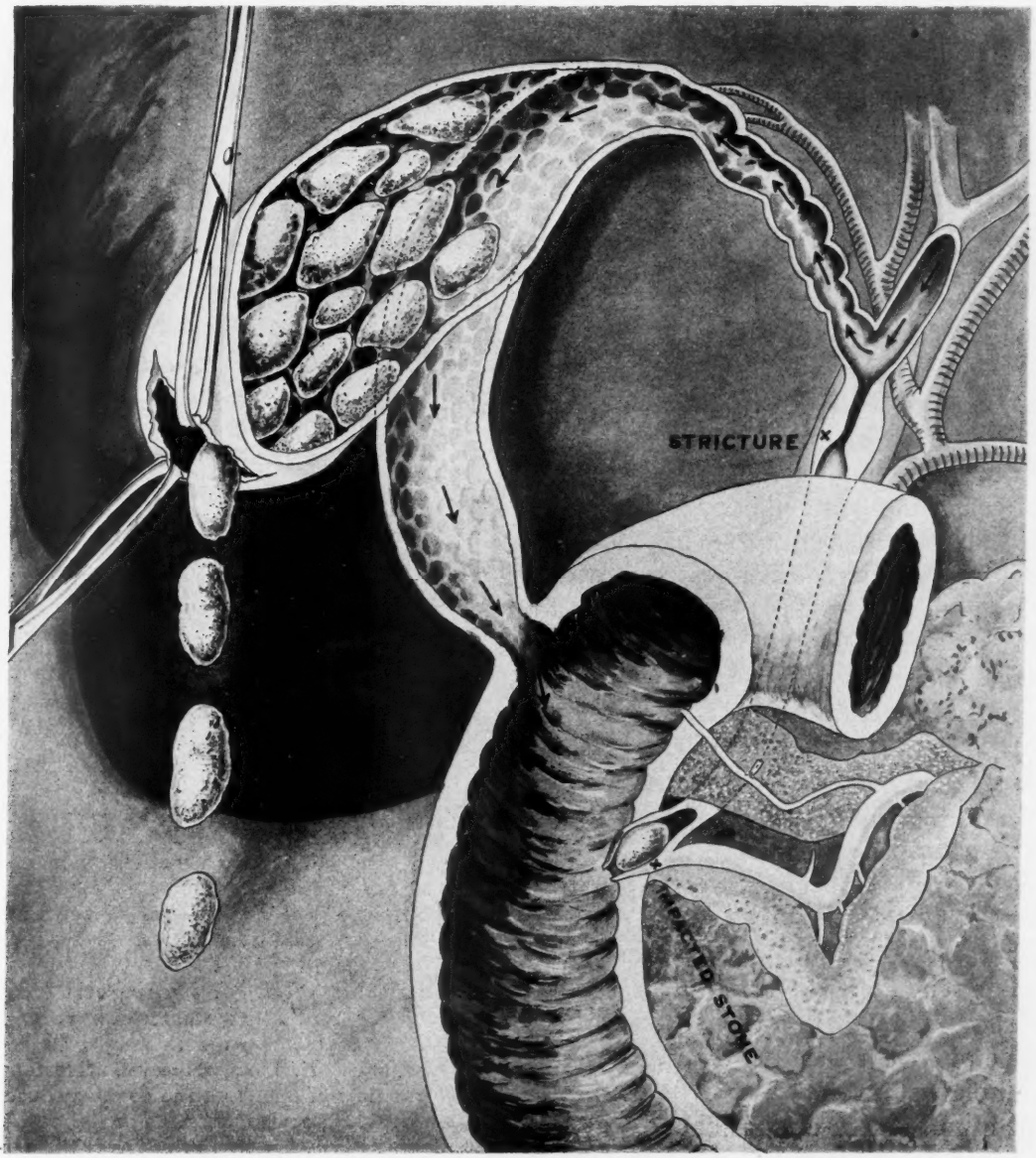

Fig. 2. Schematic cholecystoduodenostomy. Gallbladder opened; contents evacuated; fundus anastomosed to duodenum opposite papilla of Vater. The continuous flow of bile through the gallbladder prevents stone reformation and drains the whole biliary tree. The gallbladder acts as an accessory bile duct in obstruction of the common duct from stricture, neoplasm or impacted stone. (From Steel, in *Pennsylvania M. J.*, October, 1930.)

satisfied. Ten had typical symptoms every time they indulged in forbidden foods, and six claimed no relief. This would give about 84 per cent of permanent relief.

CONCLUSIONS

1. A cholecystitis may be merely part of a general biliary tract infection involving ducts, liver and frequently the pancreas.

2. Such an infection requires drainage, as evidenced by the temporary relief of symptoms, following duodenal tube drainage or by the operation of cholecystostomy.

3. Cholecystectomy, while it permanently removes the infected gallbladder, leaves the remainder of an infected biliary tree undrained. This probably accounts for the persistent biliary symptoms in 50 per cent of cases following cholecystectomy.

4. Cholecystenterostomy cleans out the infected gallbladder and gives a continuous drainage of the biliary tree and should be an ideal operation.

5. Cholecystenterostomy has not met with general surgical approval since research workers on healthy dogs reported that ascending bile duct infection followed, and that the biliary fistula closed if the common duct was not ligated.

6. We have produced evidence pointing to the facts that, in the human subject with an infected biliary tree, the danger of ascending cholangeitis is slight and that the biliary fistula does not close in the presence of a patulous common duct.

7. Cholecystenterostomy is a comparatively minor intra-abdominal operation. It has a low mortality; gives few postoperative complications; gives continuous drainage of the biliary tree and furnishes an additional functional bile duct where there is common duct pathology. (Fig. 2.) In general it seems to be the operation which does the most good with the least harm and tends to eliminate the patient who returns to haunt the office of the operator following a needless cholecystectomy.

8. In our hands cholecystogastrostomy is preferred to cholecystoduodenostomy.

I am indebted to Dr. H. T. Caswell for the compilation of the statistics of the most recent group of 100 cases.

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GENERAL PRINCIPLES IN THE TREATMENT OF THE COMMON TYPES OF STASIS ULCERS*

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FOR simplification and ease of description, let us divide the common types of stasis ulcers into two classes. To the first class are assigned those ulcers associated with chronic venous insufficiency primarily due to the incompetency of the superficial veins of the involved extremity. To the second class are assigned those ulcers whose etiologic basis usually can be traced directly to damage brought about by an attack or attacks of thrombophlebitis. In all instances, let us assume that we are dealing with ulcers of average size, shape and location which are producing average debility and symptoms. Ulcers, which because of their magnitude or severity of associated symptoms require additional therapy other than herein presented, will not be considered.

Before instituting therapy for any ulcer of the lower extremity a thorough history should be recorded and local, general and laboratory examinations should be completed. The history, in most instances, will determine to which of the aforementioned groups the ulcer should be assigned and will aid the operator in making a prognosis concerning the results to be expected from treatment. The general and laboratory examinations either should prove or disprove the tentative diagnosis of stasis ulcer. If complications or concomitant pathologic lesions should be uncovered, they can in most instances be remedied to the patient's benefit. The local examination of the extremity, particularly that of the venous systems, should be carried out prior to the institution of any type of therapy, because often a few days of rest and elevation of the part may minimize the pathologic signs and symptoms or may cause one to misinterpret the true pathologic condition of the veins.[1]

The physician's main interest and responsibility is to heal the ulcer or ulcers that are present on the extremity as rapidly as possible. His next responsibility is to maintain the extremity free from further ulcerations and to restore to that extremity as much of an adequate circulation as is possible.

It must be remembered, however, that adequate continued improvement will not be maintained unless the patient understands and will cooperate. For this reason attempts to have each patient understand the objectives of treatment are important, particularly that of the pressure pad and external support, for the application of which the patient is primarily responsible.

Usually treatment of the first aforementioned class does not offer as many problems as that of the second class. In most cases it can be shown definitely that the incompetency of the varicosities was responsible for the stasis that predisposed to the formation of the ulcer.

The usual history encountered among these individuals is as follows. Varices were noted at an early age, accompanied by the usual symptoms; then gradually, more or less in the following order there developed the evidence of continued stasis: pigmentation, edema, atrophic changes of the skin with loss of elasticity, brawny infiltration and, frequently, dermatitis. It can be seen readily that if, after such a situation has developed, some mechanism or accident causes a break in the epithelium in this region, the onset of an ulcer would occur, as is so often the case. Without adequate therapy at this stage

* From the Section on Postoperative Care, Mayo Clinic.

the ulcer will progress, no doubt owing to the stimulation of the secondary infection of the wound. The tissues and skin are not able successfully to ward off progression of this lesion because of the inadequate circulation.

The ulcers, in themselves, are frequently identical regardless of the class to which they are assigned. It is by the characteristics of the tissues that surround the ulcer that one can often identify the type of ulcer at a glance. Those extremities that have previously been involved by thrombophlebitis more frequently will demonstrate discoloration, pigmentation, edema, dermatitis, brawny infiltration and a low grade of cellulitis to a more marked degree than those of the first class. Frequently varices are not found on inspection, but by palpation in most instances their detection is not difficult.

TREATMENT

The general examination of the patient usually requires two or three days. During this period he is requested to remain quiet as much of the time as is possible with the extremity elevated to an angle of about 30 degrees and enclosed in warm moist packs of aluminum subacetate (0.5 per cent). This procedure has a twofold value: It rapidly controls the secondary infection and greatly reduces the edema. When the patient is ambulatory, external support is applied, usually in the form of elastic bandages, to maintain the extremity as free from edema as possible. If the general examination has not revealed any contraindications, the offending varices are obliterated. The methods employed depend on the type and amount of involvement.

Throughout the following week to ten days in which obliterative therapy is being instituted, the rest, elevation of the extremity and application of packs are continued whenever convenient. By this time the ulcer has usually reacted well and granulation tissue has partially or completely filled in the defect depending on the size of the lesion. The local therapy for the ulcer in most instances is minimal. As previously mentioned, the packs combat the secondary infection and elevation of the extremity reduces the edema and improves the circulation, thus in turn promoting the formation of granulation tissue. When this regimen is no longer indicated, any bland soothing ointment may be employed, primarily to prevent the dressings from adhering to the ulcer. At the Mayo Clinic we employ 3 per cent ichthammol (ichthyol) in zinc oxide for this purpose.

If more support to the extremity than the elastic bandage seems indicated, after the obliterative therapy has been completed and the local reaction to the sclerosing solution has subsided, a small dressing is applied over the ulcer, an air-foam rubber sponge is cut to the size and thickness desired and the leg is encased from the instep to just below the knee in an adhesive elastic cast which is to remain intact for five or six days or twice that period, depending on its comfort and usefulness. Excessive discharge is eliminated if the cast is applied with the proper pressure.

We never apply these elastic casts directly to the ulcer and, if there seems to be a possibility that the patient may be sensitive to the cast, the leg is covered with a bandage or stockinette before this elastic cast is applied.

Usually such a cast applied once or twice suffices to heal the ulcer entirely. If not, use of such casts may be continued as indicated. In most cases, support to the leg should be continued for six months to a year, depending on the success encountered in eliminating the edema. Elastic bandages 3 inches (7.5 cm.) wide are generally most useful for this purpose.

On dismissal the patient is carefully instructed in the care of the skin of the involved extremity or extremities. A bland oil such as olive oil should be applied daily to prevent scaling or cracking of the epithelium.

Treatment of Ulcers of Class 2. The status of the superficial systems determines

the treatment to be employed if the deep circulation is adequate and is functioning satisfactorily.[1]

If the deep circulation is not adequate, obliterative therapy must not be undertaken. Palliative therapy, such as rest, elevation and packs to control the secondary infection and edema at the onset and then the application of adequate external support, is the treatment of choice. However, if the deep circulation is functioning, therapy as previously instituted in class 1 can be carried out. It must be remembered that thrombophlebitis, besides damaging the venous system, also in practically every instance causes additional damage to the lymphatic system; thus, there occurs the usual increased and persistent edema associated with this class of ulcers.

It will be seen that additional external support other than elastic bandages is usually indicated to eliminate the edema and to allow the extremity to rehabilitate itself, particularly from the damaged lymphatic system.

Therefore, detailed instructions are given the patient in the use of Para gum rubber bandages. The ulcer or area of previous ulceration is covered in the usual way with plain gauze. If there is still slight discharge 3 per cent ichthammol (ichthyol) in zinc oxide on gauze and then a small, thin airfoam sponge are put in place. A white cotton stocking is used and should cover the whole leg to prevent the direct contact of the rubber bandage with the skin. The patient is requested to remove and reapply the cotton stocking twice a day or more frequently and never to wear one that has not been washed thoroughly; otherwise irritation, excoriation or folliculitis may develop.

The patients soon learn to apply the Para gum rubber bandages with considerable dexterity. By continued use of these bandages, employing the local hygiene as recommended, the ulcer should heal and remain healed and the condition of the extremity should continue to improve as exemplified by the increase in the elasticity and more normal general appearance of the skin.

Bandages must be worn for at least one or two years; the time depends on the improvement noted and the judgment of the physician. It is seldom that the use of bandages will be necessary throughout the patient's life.

It may be seen that the treatment for the two types of ulcer is essentially the same, except that in class 2 there may or may not be varicosities to be obliterated, depending on the status of the deep circulation, and that additional external support is necessary because of the usual additional lymphatic stasis.

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FIBROMA OF THE MUSCULOFASCIAL LAYERS OF THE ABDOMINAL WALL (DESMOID TUMORS)*

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DESMOID tumors are of interest because of their comparative rarity and the fact that they are benign and usually lend themselves to surgical excision with permanent cure if all the tumor is removed. The name desmoid was first used in the description of these tumors by Müller (1838) and indeed the word was well chosen as it represents a contraction of the two Greek words, desmos, a band or tendon, and eidos, appearance; thus the word describes a tendinous appearing tumor. Although Müller had the pleasure of naming the tumor, these fibromas apparently had been described previously by Macfarlene (1832).

In this paper I am concerned only with desmoid tumors of the musculofascial layers of the abdominal wall although similar tumors also occur in other regions, for instance in the pectoralis major, rectus femoris, gluteus, sternocleidomastoid, digastric, biceps, extensor carpi ulnaris, hamstring and masseter muscles and scapular region. They do not appear in these regions, however, with the frequency in which they are found in the abdominal wall. A recent analysis of all desmoid tumors seen at the Mayo Clinic revealed that in fifty-five or 71.4 per cent of the total of seventy-seven cases, the tumor arose in the abdominal paries.

In these fifty-five cases, women were affected more often than men for 72.7 per cent of the patients were females. Patients who had desmoid tumors were most often between the ages of 20 and 40 years. Stone found the right lower part of the abdominal wall to be involved more frequently than any other portion of the abdomen.

Although the exact etiologic factor is unknown, several observations seem to indicate that these fibromas result from trauma to the abdominal wall with hemorrhage and that the characteristics of a tumor are assumed during the process of organization of the hematoma. Bearing this out are the following observations: (1) Frequently there is a history of trauma to the region; (2) the tumors have been observed in the scars of previous surgical incisions, and (3) they are more common among women, most of whom have been pregnant one or more times, and it is possible that small hematomas may have occurred as a result of the rupture of a muscle during labor. In the series from the Mayo Clinic, 62.5 per cent of the women with desmoid tumors had been pregnant.

The gross and microscopic appearance of these tumors as well as the question of malignancy is well covered by Pearman and Mayo. They stated that a freshly removed tumor is dense, hard and tough, and creaks under the knife. The cut surface bulges, is a white or pinkish color, glistens, and the interlacing bundles of white fibrous tissue can usually be seen without difficulty. The larger tumors tend to be soft in the center, either from edema or mucoid degeneration, and some are cystic. Changes in the skin covering the tumor are unusual and involvement of the lymph nodes occurs seldom if at all.

The histologic picture is that of a rather cellular fibroma occurring in striate muscle. The central portion of the tumor is older than the peripheral portion. The elongated adult fibrous tissue cells run in strands and bundles which are interlaced in all directions after the manner of the unstriate muscle bundles in a uterine fibroid.

At the periphery where the tumor infiltrates the surrounding muscle, the tumor

* From the Division of Surgery, Mayo Clinic.

tends to be somewhat more cellular. There is no capsule or definite line of cleavage between the tumor and the adjacent muscle. When the tumor is bounded by a fascial plane, an appearance of encapsulation is produced. In spite of the infiltration there is no evidence of a sarcomatous change, such as nuclei containing large amounts of darkly stained chromatin or large multiple nucleoli, both of which are indications of rapid proliferation. Normal adult blood vessels may be noted throughout most of the tumors. The presence of these vessels indicates the slow growth of the tumor.

The special features of the tumor are the inclusion of striate muscle fibers and the sequence of regressive changes. The earliest change may be seen at the periphery of the tumor where the striate muscle is being infiltrated and broken up into constituent fibers.

The muscle fibers appear to be stretched and attenuated. They are irregular in outline and the transverse striations tend to disappear. Here and there are strands resembling unstriate muscle and foreign body-like giant cells derived from this muscle probably because of faulty nutrition.

It is easy to see that failure on the part of the surgeon to remove the tumor completely would leave strands of interfibrillar desmoid tissue and result in a local recurrence of the tumor.

The patient usually consults his physician because of finding a small hard lump (usually 3 to 8 cm. in diameter) in the abdominal wall or the patient even may have been entirely unaware of its presence until it was pointed out as a result of a general physical examination. Usually there are no subjective symptoms unless the tumor is large; then of course a dragging sensation and occasionally actual pain will be present. Walters and Church found that only a fourth of the patients in their series mentioned pain or soreness. On examination the lump is found to be fixed in the abdominal wall and seems more superficial to palpation than the usual intra-abdominal mass. It is smooth and discrete, moves with the rectus muscle and does not have the characteristic shift that

Fig. 1. Specimen removed at operation and halved showing the cut surfaces of the rectus muscle and desmoid tumor.

some intraperitoneal tumors have with deep inspiration. It is not attached to the skin and this fact helps distinguish it from a keloid. Desmoids in the abdominal wall have been mistaken for hydrops of the gallbladder, stone in the gallbladder, tumor of the omentum or mesentery, pancreatic cyst and tumor of the uterus, kidney and bone. A positive diagnosis, of course, can be made only by microscopic examination of the tumor.

Wide, surgical excision of the tumor is the treatment of choice. If the tumor is small, it may be excised to advantage in its entirety before microscopic examination confirms the diagnosis because the small tumor presents no difficulty in reconstruction of the abdominal wall. On the other hand, when a large tumor is present for which wide excision is necessary and proper reconstruction of the abdominal wall is likely to be difficult, it seems wise to confirm the diagnosis by biopsy before subjecting the patient to an extensive operation. It is doubtful whether radium therapy has any curative value in dealing with this variety of tumor.

Pearman and Mayo's recent study indicates that desmoid tumors are definitely benign and that the so-called recurrences which led previous observers to believe that some of the recurrences must be low grade malignant tumors are in effect the

result of incomplete removal. They found that many patients who had these recurrences have remained cured for years after subsequent complete operations. These observations emphasize the necessity of wide primary excision as advocated as early as 1915 by Balfour.

FIG. 2. The rectus muscle is shown on the left and the desmoid tumor on the right (low power magnification).

FIG. 3. Typical structure of desmoid tumor (medium power magnification).

The case history of a desmoid tumor which I removed is noteworthy because the patient was a male child, there was a definite history of trauma and the tumor was adherent to the costochondral juncture.

CASE REPORT

The patient was a boy aged 5 years. He was born prematurely at approximately 6 months according to the mother and forceps were used during the delivery. His development had been normal and he had been ill only once, this was at the age of 13 months and a diagnosis of chickenpox had been made. Except for tonsillectomy and adenoidectomy at 4½ years he had had no operations.

One and a half years prior to admission to the Mayo Clinic, when the child was 3½ years old, he had fallen off the bed injuring the right upper part of the abdomen. One month after the injury the doctor in his home locality had noted a small tumor. In the next four months it enlarged to the size noted on admission. There had been no pain or discomfort.

Physical examination revealed a healthy, well-developed boy without any abnormality except for a firm mass in the right upper part of the abdominal wall which seemed discrete and was three to four inches (7 to 10 cm.) in diameter. The laboratory data revealed nothing abnormal. A roentgenogram of the abdomen did not reveal calcification. The diagnosis was indeterminate although the possibility of an unresolved hematoma of the rectus muscle was entertained. Exploration and biopsy were advised. With the patient under nitrous oxide, oxygen and ether anesthesia, the tumor was explored through an upper right rectus incision and was found to be a desmoid involving the rectus muscle. It was necessary to remove a considerable portion of the rectus muscle and its sheath to extirpate the tumor which was adherent at the anterior costochondral junction and knife dissection was required to free it from the cartilage. The abdominal wall was closed with chromic catgut in the usual anatomic layers and the child's convalescence was without event. He was dismissed sixteen days later at which time the wound was healed.

The pathologists reported that the material removed consisted of a portion of right rectus

muscle and desmoid measuring 5 by 2.5 by 1 cm. (Figs. 1 to 3.)

SUMMARY

Desmoid tumors in many instances apparently arise secondary to trauma and their pathogenesis probably is related to a disturbance in the organization of the ensuing hematoma. Recent careful pathologic study of a large series of specimens removed at operation together with an analysis of the patients' subsequent postoperative histories indicate that these tumors are benign. The treatment of choice is wide surgical excision.

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THE TRANSFUSION OF CONSERVED BLOOD

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WHOLE blood for conservation can be obtained from three sources, the living donor, the human placenta, and the human cadaver. The living donor is the most frequent source, for the amount available from the average placenta is not large, and for obvious reasons the use of blood from the cadaver has not become popular in this country, although Judine[1] and other Russian writers strongly advocate the method.

COLLECTION

Whatever the source of the blood, its collection and storage must be carried out with rigidly aseptic precautions. Caps, masks and sterile gowns and gloves should be worn by the collecting team. A minimum of handling is essential. The blood should be collected in the same container in which it is to be stored and from which it will be administered later. The container is sealed as soon as the blood has been collected and is placed immediately in the refrigerator, at the optimal temperature of 5°C. Not more than 500 cc. should be collected and stored in a single flask.

Blood from the living donor is collected in the usual manner, which need not be set forth here. Placental blood is collected as follows:

As soon as the child is born the umbilical cord is clamped in two places with hemostats and is divided 5 or 6 inches from the umbilicus. The severed distal end is cleansed with alcohol or tincture of iodine, and, after the operator has put on a fresh pair of sterile gloves, is passed through a hole in a sterile towel. The blood is permitted to flow through a funnel into a sterile container in which the proper quantity of some anticoagulant fluid has been placed. The flow may be accelerated by gentle massage of the fundus uteri. The average yield of blood from each placenta is 50 cc.

The method of collecting blood from the cadaver is described by Judine[1] and other Russian writers as follows:

The cadavers to be used are those of young, healthy adults who have died suddenly from accidental causes. The blood is collected from two to six hours after death under strict aseptic precautions. The jugular vein on the right side is exposed by a small incision between the clavicular heads of the sternomastoid muscles and is lifted with two hemostats, so that ligatures can be passed beneath it. The vein is then opened and two U-shaped cannulae are inserted into it, one directed toward the heart and the other toward the brain. They are connected with sterile collecting flasks by means of sterile rubber tubing. No anticoagulant is necessary since cadaveric blood does not clot. When the body is tilted into the Trendelenburg position, blood readily flows from the cannulae into the flask. The amount of blood which can be obtained from a cadaver varies from 1,500 to 4,000 cc.

PRESERVATIVE AND ANTICOAGULANT SOLUTIONS

Each of the solutions which can be utilized for the conservation of whole blood has certain advantages. Glucose-citrate solutions, for instance, preserve blood more effectively than simple citrate solution. The various types of solution and the proper proportions of each follow:

1. 6 per cent sodium citrate solution, 10 cc. to each 100 cc. of blood.

2. 3.8 per cent sodium citrate solution, 10 cc. to each 100 cc. of blood.

3. 5.4 per cent glucose and 0.6 per cent sodium citrate solution, 100 cc. to each 100 cc. of blood.

4. Institute Hematologic Technique (I.H.T.) solution, 100 cc. to each 100 cc. of blood. I.H.T. solution consists of:

Sodium citrate	7	Gm.
Sodium chloride	5	Gm.
Potassium chloride	0.2	Gm.
Magnesium sulfate	0.004	Gm.
Distilled water to make 1,000 cc.		

All of these solutions have proved satisfactory in actual use provided that the blood is not conserved for longer periods than ten days. Other solutions, such as transfusol (sodium polyacetylen-di-sulfonate) have been recommended but do not offer any special advantages (Lattes and Rettani[2]).

Since heparin has been available in purified form (Schmitz and Fischer,[3] Charles and Scott[4]), it has been employed in transfusions and has proved useful when the blood is used immediately after its withdrawal (50 cc. of isotonic sodium chloride solution containing 3 to 5 mg. of heparin for each 600 cc. of blood). Although the status of heparin in relation to the conservation of blood is still in doubt, its use for this purpose has been recommended by Sköld[5] (25 cc. of isotonic sodium chloride solution containing 3 to 4 mg. of heparin for each 100 cc. of blood).

CHANGES IN CONSERVED BLOOD

The changes which occur in blood during conservation are influenced by a variety of factors, the most important of which are contamination, trauma to the blood during collection, the form of the container, the type of preservative solution and the source of the blood. Blood may be conserved for longer periods of time in tubular than in wide-bottomed flasks (Scudder et al.[6]). The glucose-citrate mixture, as has been mentioned, is probably the most effective preservative, but it is difficult to sterilize. Blood from the living donor can be kept for longer periods than placental blood, and placental blood can be kept longer than cadaveric blood.

The method of conservation of blood employed in the Blood Bank at Johns Hopkins Hospital (Ravitch[7]) is both simple and safe.

Even when conditions are optimal, certain changes in the conserved blood occur:

1. Leukocytes rapidly diminish in number, particularly the polynuclear cells, and their phagocytic activity decreases considerably after the first twenty-four hours of storage.

2. The blood platelets soon begin to disappear, and those which still remain exhibit marked alterations of structure by the sixth day.

3. The red blood cells become less numerous, their fragility increases and their hemoglobin content decreases. Even under optimal conditions hemolysis appears from the eighth to tenth day of conservation. The oxygen-carrying capacity of the erythrocytes which remain viable is usually normal for a period of ten days (Rous and Turner[8]).

4. Definite biochemical changes occur. The sugar diminishes, as a result of glycolysis, and lactic acid accumulates. The carbon dioxide content increases and the oxygen content decreases. The specific gravity rises and the surface tension diminishes. The glutathione content undergoes a rapid reduction (Kiguchi[9]). Inorganic phosphorus, uric acid, nonprotein nitrogen, polypeptides and aminoacids increase in amount.

5. It is generally agreed that the prothrombin content of stored blood decreases, although some divergence of opinion exists regarding the rapidity of the diminution. Rhoads and Panzer,[10] using a modification of the Quick method, found a loss of half of the total initial amount of prothrombin during the first three days of conservation. DeGowin,[11] on the other hand, using the method devised at the University of Iowa, found the prothrombin content of the stored blood not much reduced until the fifteenth day.

TABLE I

REACTIONS FOLLOWING CONSERVED BLOOD TRANSFUSION

Author	Source of Blood	Preservative Solution	Number of Transfusions	Incidence of Reactions, Per Cent	Nature of Reactions
Kiguchi	Donor	Sodium citrate	53	15	Headache, urticaria
Fantus (Cook County Hospital).	Donor	Sodium citrate and sodium chloride	962	13.5	Not stated
Wilson and Jamieson	Donor	Sodium citrate	14	14.2	Rigor, fever
Sammartino	Donor	Glucose citrate	167	8.3	Rigor, fever, lumbar pains
Tachella Costa	Donor	Not stated	11	54.5	Rigor, fever
Jonesco	Donor	Sodium citrate	2	0	
Vlados	Donor	I.H.T.	22	9.0	Rigor, fever
Domanig	Donor	I.H.T.	18	11.1	Rigor, fever, hemoglobinuria
Jeanneney and Vieroz	Donor	Sodium citrate	70	8.5	Rigor, fever, transient hemiparesis
Gnoinski	Donor	Sodium citrate	6 Blood conserved for 60 to 90 days	83.3	Rigor, fever, hemoglobinuria
Cameron and Ferguson (Philadelphia General Hosp.).	Donor	Sodium citrate	1000	7.4	Rigor, fever, hemoglobinuria
Elliott, Macfarlane and Vaughan	Donor	I.H.T.	50	20	Rigor, fever, jaundice
Boland, Craig and Jacobs	Donor, Placenta	I.H.T.	38	10.5	Not stated
Robertson	Donor	Glucose citrate	22	4.5	Rigor, fever
Picinelli	Placenta	Sodium citrate	5	40	Hemoglobinuria, rigor, fever
Gwynn and Alsever	Placenta	Glucose citrate and sodium chloride	18	11.1	Rigor, hematuria
Page, Seager, and Ward	Placenta	Sodium citrate and sodium chloride	25	Several, one severe	Not stated
Halbrecht	Placenta	Sodium citrate	116	3.4	Rigor, dyspnea, tachycardia
Grodberg and Carey	Placenta	Sodium citrate	75	4.0	Not stated
Judine	Cadaver	None	1000	12.5 (5 deaths)	Rigor, fever, hemoglobinuria, jaundice, diarrhea
Shamov	Cadaver	I.H.T.	42	14.2	Not stated
Bellelli	Cadaver	I.H.T.	47	29.7	Rigor, fever, albuminuria, vomiting, diarrhea, jaundice
Judine and Skundina	Cadaver	None	350	21.0 (5 deaths)	Hemolytic shock, anaphylactic shock
Skundina	Cadaver	None	200	21.0 (4 deaths)	Anaphylactic shock, hemolytic shock, phlegmon of arm

6. The free potassium content of the plasma increases with conservation, due to its diffusion from the red blood cells (Dulière,[12] Jeanneney and Servantié[13]) and the accumulation may be the cause of post-transfusion reactions (Scudder et al.[6]).

METHOD OF ADMINISTRATION

The conserved blood should be administered directly from the flask in which it has been stored, after its compatibility with the blood of the prospective recipient has been determined. It should be filtered through six or eight layers of gauze before it is transfused.

Warming of the blood must be done with the greatest care, and during the process the flask should be gently rotated, in order to mix the plasma and cellular elements. Excessive heating will lead to coagulation of the plasma proteins, which will result in severe post-transfusion reactions. For this reason several workers prefer to use unheated blood, which has apparently given satisfactory results (Wilson and Jamieson[14]). By this method the blood is allowed to remain at room temperature for several hours after it has been removed from the refrigerator. The rate of administration should not exceed 10 cc. per minute. Slowing of the flow is frequently caused by a spasm of the vein wall as unheated blood is administered.

The amount of blood to be administered depends upon the indications for the transfusion. Patients suffering from shock may be given 500 to 1,000 cc. Judine[1] has given as much as 1,500 cc. at a single transfusion. The use of placental blood is less practical when large amounts are required. The pooling of blood from several placentas may be considered, but this method increases the incidence of post-transfusion reactions.

INDICATIONS

The indications for transfusion with conserved blood do not differ from the indications for transfusion with fresh blood. They include hemorrhage, with or without shock, anemia due to repeated hemorrhage, anemia due to sepsis and acute septicemias.

The contraindications to transfusion with conserved blood are not yet clear, but certain precautions should obviously be remembered when this method is employed. Blood which has been stored longer than twenty-four hours should not be used when a hemostatic effect is desired. Opinions differ, as has been pointed out, as to when the prothrombin content of the blood begins to decrease, but in view of the findings of Rhoads and Panzer that the fall begins at the end of twenty-four hours, it is clearly safer not to use conserved blood for hemostatic purposes after this time. Furthermore, since the phagocytic activity of the leukocytes decreases in conserved blood, it is inadvisable to perform transfusion with it for acute infections after more than forty-eight hours of storage.

CLINICAL RESULTS

The experiences of observers in widely scattered areas would seem to indicate that the clinical results of transfusion with conserved blood do not differ greatly from those of transfusion with fresh blood. There are, however, distinct disadvantages to the use of conserved blood, including:

1. Great dilution of the blood, associated with the use of certain preservative solutions.
2. A less effective augmentation of the number of red blood cells and hemoglobin content of the blood of the recipient, due to the changes in these respects in the conserved blood.
3. A higher incidence of post-transfusion reactions.

POST-TRANSFUSION REACTIONS

Considerable difficulty is encountered in attempting to evaluate the statistical incidence of reactions following transfusion with conserved blood, chiefly because of the variation of criteria used by different workers. From available data, however, certain general statements can be made (Table 1):

1. In a total of 2,373 collected transfusions of conserved donor blood the incidence of reactions was 13.8 per cent.* In a total of 214 collected transfusions with conserved placental blood the incidence of reactions was 14.6 per cent. In a total of 1,639 collected transfusions with conserved cadaveric blood the incidence of reactions was 19.6 per cent. The severest reactions and the only fatalities on record followed the utilization of conserved cadaveric blood. The reactions varied from mild rigors and elevations of temperature to icterus, hemoglobinuria, hematuria, diarrhea, vomiting, and anaphylactic and hemolytic shock.

2. Attempts to decrease the number of reactions in the future use of this method will depend upon:

(*A*) Improved methods of collecting, storing and administering conserved blood.

(*B*) A more detailed knowledge of the physiological and chemical changes which occur during the conservation of the blood.

(*C*) Clearer delimitation of the indications for and contraindications to transfusion with conserved blood. At the present time, as has been pointed out, the contraindications are largely unknown.

SUMMARY

A brief résumé has been given of the technic and results of transfusion with conserved blood. Conserved blood from a living donor is superior to blood obtained from the placenta or the cadaver but is inferior to fresh blood from a living donor.

* In making up these tabulations the series recorded by Gnoinski[15] has been omitted. He used blood which had been conserved for periods of sixty to ninety days and reported reactions in 83.3 per cent of his cases.

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ARTIFICIAL PNEUMOTHORAX

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THE term, "artificial pneumothorax," or more properly, induced pneumothorax, as ordinarily used means air within the pleural cavity which has been introduced by *mechanical* means, rather than spontaneously or traumatically. Forlanini, in 1882, and J. B. Murphy, in 1898, independently of each other, described patients with pulmonary tuberculosis who had been benefited by induced pneumothorax, and it is still in this disease that the procedure has its widest applications.

Indications. The indications for induced pneumothorax in pulmonary tuberculosis are mainly: (1) progressive lesions; (2) cavities and (3) hemorrhage. There is, however, a great difference of opinion as to the indications in different stages of the disease, so that a tabulation that would be universally accepted is not possible. The following may be listed: (1) infiltrative lesions, with or without small cavities and with positive sputum which do not improve after a short trial of bed rest; (2) larger cavities; (3) pneumonic lesions confined to one lobe; (4) early infiltrative lesions with negative sputum which do not respond to a period of three to six months of bed rest, and (5) profuse or protracted hemoptysis. Contraindications are: (1) bilateral, far advanced disease; (2) markedly impaired respiratory reserve as indicated by dyspnea at rest or upon slight exertion, or by a vital capacity of less than 1200 to 1500 cc.; (3) decompensated cardiac or renal disease, and (4) active hematogenous tuberculosis with extensive extrapulmonary involvement.

Induced pneumothorax finds application in the diagnosis and treatment of several nontuberculous thoracic diseases. In the hands of some, including the author, it has been beneficial in the early stages of suppurative bronchiectasis. Most thoracic surgeons require a short period of pneumothorax preliminary to exploratory thoracotomy for pulmonary or mediastinal tumors; this serves the twofold purpose of stabilizing the mediastinum and of accustoming the patient to increased demands on his respiratory reserve. Pneumothorax is sometimes of value as an aid in the roentgenographic differentiation of chest wall tumors and other extrapleural masses from intrapulmonary lesions.

The induction of a pneumothorax should be performed in a hospital or sanatorium where the patient can be closely observed until the lung is well collapsed, and preferably until cavity closure has been effected. The technic described is that which is used on the Division of Pulmonary Diseases of Montefiore Hospital. Many variations in one or more of the steps are practiced, some of which will be noted.

Apparatus. A pneumothorax apparatus (Fig. 1) is required. Many different ones have been devised, all of which contain two essential elements: (1) a manometer* (*A*) for the measurement of intrapleural pressure, and (2) a mechanism to drive air into the pleural space. Most apparatuses used in this country feature a two-bottle arrangement in which the level of water in one, (*E*), can be raised above that in the other, (*D*). The flow of water thus created forces the air in the lower bottle into a rubber tube, (*F*), which can be connected to the puncture needle. By means of valves, the continuity of the tube with the manometer (valve *B*), and the flow of air, (*C*), can be controlled; both valves should not be open at the same time. The gas used is ordinary room air which is filtered through

* A water manometer is the most satisfactory.

cotton, (*G*), placed at one point in the tubing. It is no longer believed that the use of nitrogen, carbon dioxide, etc., has any advantage. The author personally finds great satisfaction in the use of the Davidson apparatus.*

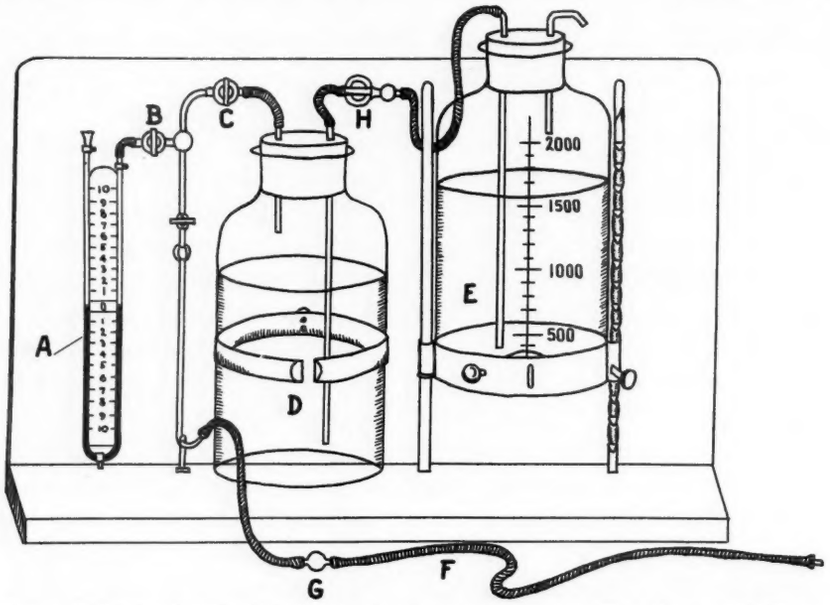

Fig. 1. Pneumothorax apparatus. *A*, water manometer. *B*, valve controlling continuity of rubber tube with manometer. *C*, valve controlling continuity of rubber tube with lower bottles; by means of this, the flow of water can be regulated. *D*, bottle containing water and air. *E*, graduated outer bottle which can be elevated or lowered so that water will flow out of or into it. *F*, rubber tube, the end of which can be attached to the puncture needle. *G*, cotton filter. *H*, valve between the two water bottles; this is ordinarily kept open.

A sterile tray is provided, containing a three-way stopcock (Fig. 2A), several 2 cc. hypodermic syringes, ½ inch 26 gauge needles, puncture needles (Fig. 2B), 3 medicine glasses (for alcohol, iodine and 1 per cent procaine), applicators, gauze pads and towels.† The puncture needles should be 18 gauge and 2 inches long, though for the average sized chest, a length of 1½ inches is sufficient. The needle should have a short bevel and its point should be sharp enough to permit easy penetration of the chest wall, yet blunt enough to minimize the possibility of puncturing the lung. Ampoules of caffeine and epinephrine are kept in the treatment room at all times.

* Manufactured by J. Sklar, Brooklyn, N. Y.

† A towel 1 foot square with a reinforced hole about 4 inches in diameter in the center is useful.

TECHNIC

Ordinarily, no preliminary medication is required. The patient is placed in the lateral recumbent position with the operated side up. A pillow is folded and placed under the chest so that the thorax is at a higher level than the head and feet. The operator stands at the patient's back and the pneumothorax apparatus is placed in front of him, thus distracting his attention from the manipulations incident to the puncture. An assistant regulates the apparatus. The site selected for the puncture should be well away from the diseased area. Since, in most cases, the lesions are in the upper lobe, a favored location is the sixth or seventh interspace in the midaxillary line.

The field is sterilized and draped. The author prefers a thorough scrub-up to using gloves. The selected site is infiltrated with a local anesthetic as deeply as a ½ inch needle will reach.* The valves of the

* Many advocate infiltration down to the parietal pleura.

pneumothorax apparatus are set for manometric registration (by opening *B* and closing *C*). Oscillation of the manometer is carefully watched for movement, and it is occasionally depressed a little to clear the needle of tissue plugs. When the

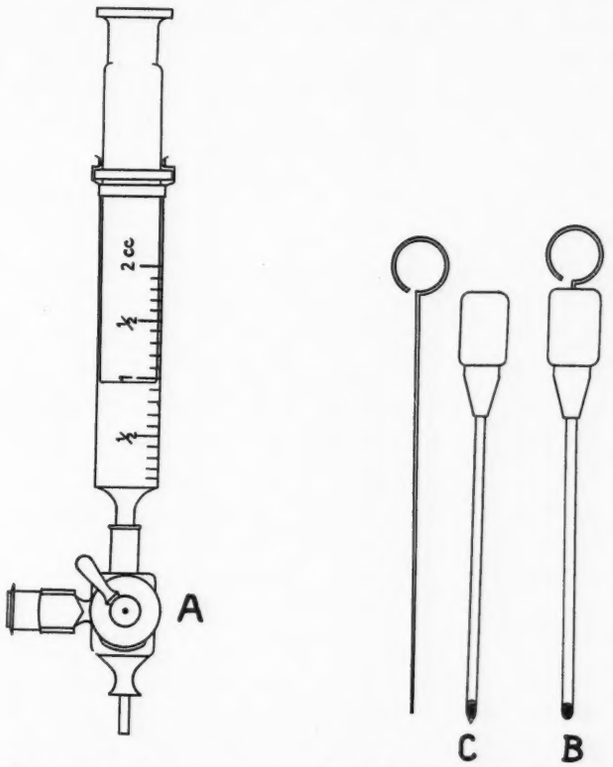

Fig. 2. *A*, three-way stopcock with attached syringe. *B*, blunt needle suitable for induction of pneumothorax. *C*, sharp needle used for refills.

when the rubber tube is squeezed confirms the patency of the system. The puncture needle is now connected to the three-way stopcock into the opposite end of which is inserted a hypodermic syringe almost full of anesthetic solution; the stopcock is set so that the needle and syringe are in communication and then the rubber tube of the pneumothorax apparatus is attached to the sidearm. The needle, held vertically to the chest, is thrust into the skin* and slowly pushed deeper and deeper; the rapidity of insertion depends upon the skill and experience of the operator. At this point the patient is cautioned to avoid coughing, talking or deep breathing, any of which may cause sudden expansion of the lung against the needle.

The position of the piston of the syringe parietal pleura is punctured, a slight snap will often be transmitted to the fingertips. More important, if the tip of the needle is in the pleural cavity, the piston will begin a fairly rapid descent as a result of the negative pressure within the space. It is then necessary to make sure that the needle is not in the lung; this is indicated if gentle traction on the piston causes air or blood to enter the syringe. Unless this occurs, the stopcock is then turned so that the needle is in communication through the rubber tube with the manometer of the apparatus.*

* When a very blunt needle is used, a preliminary opening in the skin may be made with a sharp needle.

* Several other methods of locating the pleural space are satisfactory. Some prefer to have the stopcock set so that the needle is in communication with the manometer when the puncture is being made, and to watch for the appearance of true intrapleural readings. Others use an unconnected needle filled to the hub with fluid, sudden inward suction of which indicates entry into the pleural cavity.

If the tip of the needle is truly within the pleural space, there should be an immediate negative reading on the manometer. This will then oscillate synchronously with the phases of respiration, being lower (more negative) on inspiration, but negative during both inspiration and expiration, with a minimum excursion of 3 cm.* *No air should be introduced unless the manometer indicates characteristic intrapleural pressure readings.*

A small amount of air (25 cc.) is then given (by closing valve *B* and opening *C*) and a reading is taken. The presence of adhesions is indicated by a pressure change in a positive direction. If the adhesions are very extensive, the pressure actually will become positive and pain will appear. Another 25 cc. of air are introduced, then 50 cc., each amount being followed by a reading. Unless the pressure becomes quite positive (more than plus 6), the remainder of the desired amount may then be given. Except in a special situation such as hemoptysis which requires a large initial collapse, about 250 to 300 cc. are usually sufficient.

Following the insufflation, the patient is kept in the treatment room for at least fifteen minutes, during which period the pneumothorax apparatus and the sterile instruments are left in place. This precaution permits prompt detection and treatment of a tension pneumothorax which may occasionally occur. The patient is required to remain in bed for the first 24 hours. Rather severe pleuritic pain may necessitate the liberal administration of codein.

Although it is often possible to suspect from the roentgen film that an adherent pleura will prevent induction of pneumothorax, one can be certain of this only by actually attempting the procedure. If a free pleural space is not located, a second attempt is made about two interspaces away. No more than three unsuccessful attempts should be made at one session, and if similar failures occur on a subsequent day, further efforts should be abandoned.

A refill is given on the day following induction (the puncture being made close to the site of the original one) and every two or three days thereafter until the desired degree of collapse is achieved. For the first few refills, the technic is the same as that used for an induction, but is simplified by the fact that the entry of the needle into the pleural cavity is marked by the return of air into the syringe. Once the lung is well separated from the thoracic wall, a 20 gauge sharp needle (Fig. 2C) may be used; many prefer a single rapid thrust without previous anesthesia. When this technic is used, the author keeps the stylet in the needle almost to the tip during the puncture. After passage of the parietal pleura, it is pushed a little further, thus clearing the lumen of the needle.

COMPLICATIONS

Induced pneumothorax is subject to a number of complications. Only the more serious will be discussed:—

A. Air Embolus. This is the most dreaded complication of pneumothorax. It is caused by the entry of large quantities of air into a pulmonary vein. It most frequently occurs during induction, particularly when adhesions are present. It results from insufflation while the tip of the needle lies within a vein; or pleural or alveolar air may enter a vein if the surface of the lung, particularly in a fibrotic area, has been lacerated. The symptoms are abrupt in onset, vary in form and severity and are referable to embolization, especially of the brain. In severe cases, death may be almost instantaneous. Other symptoms are vertigo, headache, blurred vision, convulsions, syncope, cyanosis and blanching of one side of the tongue. The best treatment is prophylaxis; blunt needles should be used for induction, talking or coughing during insufflation should be forbidden and air should never be introduced unless the pressure readings are characteristically intrapleural. Once the accident has

* A reading of minus 2, plus 2 indicates that the needle is in a bronchus.

occurred the patient's head is lowered, warmth is applied and stimulants are given.

B. Tension Pneumothorax. A laceration of the surface of the lung may occur as the result of a needle puncture, or spontaneously due to the tearing of an adhesion during forceful coughing. If the opening does not promptly seal itself, a tension pneumothorax will develop, and the mediastinum, if not fixed by adhesions, will shift toward the opposite side, causing an alarming degree of dyspnea. Prompt deflation then becomes necessary. The technic is the same as that used for insufflation, but the bottles of the apparatus are reversed. Following this, continuous deflation is necessary, often for several days. This is done by connecting the pneumothorax needle to a rubber tube whose other end is under water.*

C. Fluid. A large number of patients with tuberculosis who receive induced pneumothorax sooner or later develop pleural effusions of varying amount and character. Most of these are relatively innocuous and eventually absorb; some, particularly those whose onset is marked by severe toxic symptoms, turn into tuberculous empyemas. Diagnostic aspiration should be performed frequently; large amounts may be withdrawn if dyspnea appears. The management of these effusions is the subject of great controversy; for details, reference may be made to the extensive literature on the subject.

Adhesions. In many cases it will become apparent within a few weeks after induction that adhesions are preventing satisfactory collapse of the diseased area. The involved portion may be so broadly adherent that only healthy lung is being collapsed, in which event the pneumothorax should be abandoned. If, however, the adhesions appear less extensive, a thoracoscopy should be performed by an experienced surgeon; in this procedure, the adhesions are inspected and, if possible, severed (intrapleural pneumonolysis, Jacobaeus operation). It is thus often possible to convert an ineffective pneumothorax into a satisfactory one.

After Treatment. The most desirable degree of collapse is that which is just sufficient to be effective as indicated by the satisfaction of the following criteria: (1) cavity closure; (2) conversion of sputum,* and (3) disappearance of symptoms, both local and constitutional. Once this collapse has been achieved, refills should be given just often enough for its maintenance at a *constant* level. The patient should be fluoroscoped before each refill, at which time the degree of collapse, position of the mediastinum and presence of adhesions or fluid are noted. Positive intrapleural pressures and undue shift of the mediastinum should be avoided. With the passage of time, thickening of the pleura may result in diminished absorption of air, so that the space can be maintained by small refills several weeks apart.

Most induced pneumothoraces become effective within a few months, if ever. The percentage of those becoming effective after this period diminishes with the passage of each succeeding month. When it becomes apparent that unseverable adhesions are preventing cavity closure, the procedure should be abandoned. If, however, all cavities appear to be closed, but the sputum remains positive, a bronchoscopic examination for the detection of tuberculous lesions of the trachea or major bronchi should be made. No fixed rule can be given for the length of time that a successful pneumothorax should be maintained. On our service we have set the arbitrary rule of continuing treatment for four years after cavity closure and sputum conversion. When the decision to discontinue pneumothorax has been made, no further refills are given, and the lung is watched by frequent fluoroscopic examinations until it has completely reexpanded.

* More elaborate apparatuses for deflation are described in the reference texts.

* Negative sputum implies that smears, cultures and guinea pig inoculations have been done on both sputum and gastric contents.

Bilateral Pneumothorax. In certain patients with bilateral disease, it is possible to treat both sides by induced pneumothorax. Usually the side with the more extensive lesion is treated first. It is best not to induce the second side until the first space is well established and thoracoscopy, if necessary, has been performed. The vital capacity should be determined to ascertain the ability of the patient to withstand bilateral collapse. After the second pneumothorax has been established, each side should be treated independently. However, respiratory embarrassment must be avoided by maintaining the smallest degree of collapse possible. Refills should never be given on both sides on the same day.

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STAB THORACOTOMY IN THE TREATMENT OF ACUTE PLEURAL INFECTION

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VARIOUS types of therapy, both medical and surgical, have been recommended in cases of acute pleural suppuration. These range in magnitude from needle aspiration to major thoracotomy with removal of segments of several ribs. Although certain authors have attempted to standardize the treatment of the condition, experience has indicated that the most satisfactory results are obtained by selecting the type of therapy best suited to the requirements of the individual case. This requires an appreciation not only of the advantages but also of the disadvantages of the various forms of treatment which have been proposed. Among the surgical methods, the most important minor procedure is stab (intercostal) thoracotomy. The advantages of this procedure include simplicity, freedom from shock and ease of performance. Thus it can be readily carried out under local anesthesia with only a few simple instruments. The patient, if very ill, need not be removed from bed, and if necessary the procedure can be performed at home as well as in the hospital. These features render it an excellent emergency method in the treatment of many patients who are critically ill. In certain cases more liberal drainage by open thoracotomy subsequently may be required, while in others the initial procedure may prove curative.

A rather considerable number of cases of pleural infection, especially among children, are characterized by the rapid outpouring of a large quantity of infected fluid which not only compresses the underlying lung but also displaces the heart and mediastinal structures toward the opposite side and thereby compresses the contralateral normal lung. Such a situation usually results in extreme respiratory and circulatory embarrassment to which profound intoxication is often added as the result of septic absorption from the large, tense, collection of infected fluid. If the pulmonary inflammatory process, from which the pleural infection originally was derived, is still active, another complicating factor is present. Such a situation is frequently encountered in children suffering from so-called "synpneumonic" empyema. In cases of this type, the infection often begins within a few days after the onset of pneumonia and the latter may be at its height when widespread, pleural infection supervenes. In children also, necrosuppurative bronchopneumonic lesions often perforate into the pleura and produce pyopneumothorax rather than empyema (pyothorax). If the pulmonary perforation is of large size and a free communication between the lung and pleura results, substantial quantities of air enter the empyema cavity. This usually produces an extreme degree of pulmonary compression and mediastinal displacement.

In cases of the types just described, relief of symptoms is required promptly. Because of the fact that the purulent effusion is thin at an early stage of pleural infection, it is safe to assume that the effusion contains comparatively little fibrin and, therefore, the mediastinum is not well fixed by fibrinous exudate upon its surface. For this reason, "open" thoracotomy is contraindicated and the procedure usually advocated is repeated aspiration until such time as the fluid becomes sufficiently thick to render open thoracotomy safe. This usually requires from seven to ten days.

The utilization of repeated pleural aspiration to tide the patient over the critical period has a number of serious disadvantages which include the following: (1) Drainage is not continuous but is inter-

mittent. (2) In certain types of pleural infection, notably that due to the hemolytic streptococcus, the re-accumulation of fluid is so rapid that aspiration may be required several times a day in order to keep the symptoms under control. (3) Repeated punctures, especially when the pleural infection is of the streptococcic variety, may result in serious phlegmonous infection of the chest wall. (4) Repeated incomplete emptying of the empyema cavity by aspiration may result in irregular expansion of the lung, thus converting a single, large, empyema cavity into a series of smaller loculations. This not only may render subsequent surgery more likely, but often renders such surgery difficult and the results less satisfactory. (5) Repeated aspirations are distressing to the patient (especially if a child). (6) If tense pyopneumothorax, due to the free entry of air into the empyema cavity is present, aspiration has only very transient effects.

Stab thoracotomy combined with "air-tight" drainage is a procedure which is free from all these objections. It permits the continuous escape of the contents of the empyema cavity. Furthermore, by preventing the entry of air into the chest through the drainage tube, it permits return of the displaced heart and mediastinum to their normal positions, prevents their further abnormal mobility and facilitates re-expansion of the lung. Thus, respiratory and circulatory embarrassment and intoxication are rapidly, effectively and continuously combatted by means of a single, minor procedure which can be performed within a few minutes.

In other cases, a large purulent effusion may have developed comparatively slowly and diagnostic aspiration may have disclosed pus sufficiently thick to permit major thoracotomy without fear of undue mediastinal mobility. In such cases, however, the sudden release of a large, tense collection of pus by rib resection and the actual trauma of a procedure of such magnitude may produce an alarming "shock-like" state, especially if the patient is toxic or debilitated. Stab thoracotomy is well suited to such cases for two reasons, first, because it is not a shocking procedure, and second, because the rate of decompression can be regulated through the use of an adjustable clamp applied to the drainage tube. In such cases, the end of the drainage tube may be left open and "air-tight" drainage dispensed with. In addition it is the custom of some surgeons to combine this type of drainage with certain forms of irrigation of the empyema cavity; and if the infection is controlled thereby, subsequent major thoracotomy may prove unnecessary.

Stab thoracotomy with "air-tight" drainage is contraindicated for obvious reasons in cases of empyema in which single or multiple, small encapsulations are present. Another contraindication exists in cases of anaerobic pleural infection resulting from the perforation of a putrid pulmonary abscess. Such pleural infections usually are serious and often fatal. The cardinal principle of treatment is to provide free aeration without delay in order to combat the virulent anaerobic infection. Personal experience has indicated that for this purpose stab thoracotomy seldom is adequate and that wide thoracotomy with free rib resection is the procedure of choice.

PROCEDURE

Although the use of a number of devices, including special cannulae and drainage tubes, has been recommended in stab thoracotomy, the procedure can be performed readily with the usual instruments. In order to secure dependent drainage the operative approach is made near the lower limit of the purulent collection. The instruments required are a syringe for the administration of local anesthesia, a few small, sharp-pointed, artery forceps and a scalpel. The remaining equipment consists of a moderately firm rubber drainage tube (about 10 or 12 inches long with a lumen ¼ to ⅜ inch in diameter), a glass connecting tube, 3 feet of conducting tubing and a 1,000 cc. collecting bottle filled with water

to a depth of several inches. The distal end of the conducting tube is placed about 1 inch below the level of the water in the collecting bottle and is fixed to the neck of the bottle by adhesive straps. This prevents the end of the tube from being accidentally withdrawn from the water which forms a one-way valve permitting pus to escape from the tube but preventing the entry of air into the latter. The proximal end of the conducting tube is attached to the distal end of the drainage tube by means of the glass connecting tube. The drainage tube is prepared by clamping off the distal end close to the glass connecting piece. The proximal end is cut on the bias and a side opening made about 1 inch from the tip. A rubber collar, made of a short section of slightly larger sized rubber tubing, is slipped over the drainage tube and placed at a distance of 2 to 3 inches from the tip, depending on the thickness of the patient's thoracic wall and overlying tissues. The assembled unit is then ready for use.

The skin, subcutaneous tissues and intercostal muscles are injected thoroughly with ½ per cent novocaine at the site previously selected. Care is taken to inject all the tissues down to and including the parietal pleura. An incision about ½ inch long is made through the skin and subcutaneous tissues and partially through the intercostal muscles. The proximal end of the drainage tube is grasped with a small, sharp-pointed, artery forceps in such a manner that the tip of the clamp projects about ¼ inch distally to the tip of the tube. The tip of the artery forceps which grasps the tube is introduced into the operative incision and then is gently but firmly forced through the deep (uncut) layer of intercostal muscles and pleura into the empyema cavity. The tube is firmly held in situ with the free hand, while the artery forceps is unclamped and withdrawn. The drainage tube is fixed in place by passing several safety pins through the collar and strapping them securely to the skin with numerous strips of adhesive tape which pass over them in various directions. The artery forceps applied to the distal end of the tube, finally is unclamped and the contents of the empyema cavity permitted to drain into the collecting bottle which is placed on the floor at the bedside. An artery forceps is always kept at the bedside in order to clamp off the collecting tube whenever the distal end of the latter has to be removed from beneath the water in order to empty the bottle. The only other precaution to be observed is never to raise the collecting bottle to the level of the patient unless the tube is clamped off. Failure to observe this rule may result in the passage of fluid from the bottle into the chest should the patient cough or take an unexpectedly deep breath.

Although various devices have been employed to regulate the degree of negativity within the empyema cavity and drainage system, we have found the simple apparatus described above to serve its purpose adequately. Furthermore, it requires practically no attention except to empty the collecting bottle once a day and to refill it partially with water.

PENETRATING WOUNDS OF THE HEART

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PENETRATING wounds of the heart are emergency cases, but in any emergency it is well to take thought of what to do before doing it. The complications of immediate importance are hemorrhage and pericardial tamponade. As little as 200 or 300 c.c. of blood may so distend the relatively inelastic pericardial sac that ventricular diastole cannot occur. By preventing ventricular filling pericardial tamponade prevents ventricular output into the general circulation, with arterial failure, cerebral anoxia, unconsciousness and collapse.

As the thoracic and mediastinal contents are held under a negative pressure the flow of blood in the venae cavae and right auricle, "the great venous gateway to the heart," is under a sucking pressure estimated to equal about 8 to 10 cm. of water. When the positive pressure upon the heart from pericardial tamponade equals or overcomes this, the circulation comes to a standstill until the venous engorgement outside the thorax builds up sufficient pressure to force blood into the heart again. If the elastic recoil of the lungs is not lessened by pneumothorax the circulation may be maintained for some time longer. But eventually this mechanism fails and death ensues.

Whether the symptoms of collapse are due to shock or to hemorrhage and tamponade is an important matter. Loss of blood from the general circulation calls for suitable fluids. Every office should be equipped with bottles of sterile normal salt solution, 5 per cent dextrose and possibly a suitable acacia solution. These may be obtained with sterile-pack tubing and needles from several pharmaceutical supply houses. Experience shows that intravenous infusion in these cases seldom does harm and may be life saving.

Exact differential diagnosis may be difficult and preparation for operation should be instituted at once. If the entrance wound has produced pneumothorax the local heart signs may be obscured. Fluoroscopic examination, if quickly available, is of assistance in diagnosing tamponade as the heart shadow is enlarged and the heart excursions lessened. Rapid pulse, air hunger and restlessness on the part of the patient suggest hemorrhage, while a low arterial pressure, faint or absent pulse, "quiet" heart and unconsciousness suggest tamponade. However, free bleeding into the pleural space may divert so much blood from the brain that syncope may result. Wounds in the ventricles bleed more furiously because of the increased pumping pressure and are more likely to fill the pericardium. Wounds in the auricles, unless large, bleed more slowly and are less likely to strip loose the pericardium and produce tamponade. Blood may be lost into the pleural space instead.

Bigger[1] divides heart wounds into four groups: (1) those with slight or moderate bleeding in which the wounds communicate freely with the pleura. They are treated conservatively. In group 2 are patients with tamponade who improve after fluid infusion, adrenalin and morphine. These patients are prepared for operation. While this is being done a cannula is inserted into the pericardium to determine the pressure and if possible to remove some of the blood, relieve the tamponade and allow better heart action. The cannula is left in for fifteen to thirty minutes and if bleeding recurs operation is done at once. Group 3 includes those cases with severe tamponade and low arterial pressure, which do not respond to conservative measures. They should be operated upon without delay, pericardial aspiration being done mean-

while. Group 4 includes patients with free communication with the pleura and massive hemorrhage. They should be operated upon at once and the blood reinfused while attempts are made to control the hemorrhage. Bigger remarks that few patients with this type of injury survive sufficiently long to secure surgical aid.

FIG. 1. Location of stab wound in right auricle.

Briefly, the things to be noted immediately upon seeing a patient with a heart injury are: (1) character of the pulse (present, absent, fast, slow); (2) character of the heart action ("quiet" in tamponade); (3) quality of the arterial pressure; (4) color and demeanor of the patient (restless in hemorrhage, quiet in tamponade; ashy color in tamponade; pale in hemorrhage).

Things to do: (1) administer saline or acacia infusion if indicated; (2) give adrenalin or neosynephrin to maintain arterial pressure; (3) morphine if restless. Prepare field for operation.

Operative Treatment. Several incisions have been described in texts and Elkin[2] has pointed out the advantages of various incisions, especially the transverse incision separating the pectoral fibers with rib resection beneath the retracted muscle. Any approach which is time consuming, shocking, or which involves bulky instruments such as rib spreaders, should be avoided. If the entrance wound indicates injury to the lung a transpleural approach permits examination and treatment as well as removal of blood from the pleural space. If pericardial tamponade is present, exposure must be adequate to allow control of the wound which bleeds freely when release of the tamponade allows the circulation to become active again. If a transpleural approach is made the collapsed lung flaps about with respirations and voluminous gauze packing is necessary to control undue movement during operation.

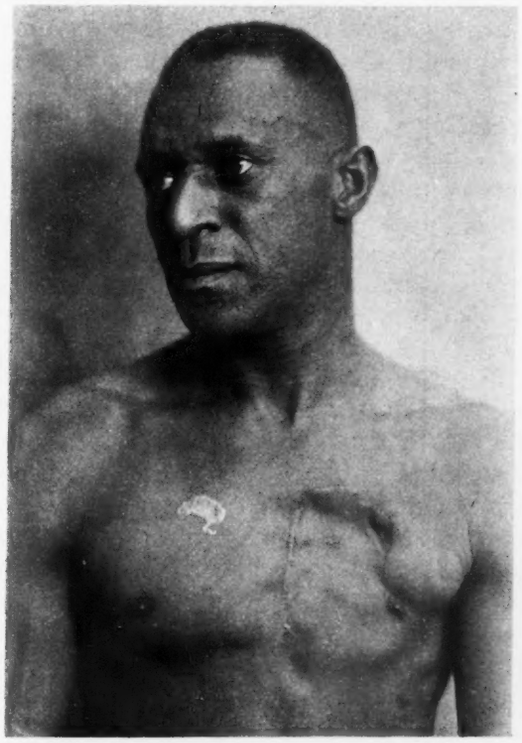

FIG. 2. Postoperative appearance of patient.

General anesthesia is probably best because with the release of tamponade, improvement of the circulation and partial return of consciousness, these patients become unruly. The pleural reflex induced by the necessary manipulations and open pneumothorax would be troublesome were local anesthesia used. If an anesthesia apparatus is used some positive pressure may be exerted upon the collapsed lung and the administration of oxygen and carbon dioxide may be carried out when indicated.

CASE REPORT

H. C., 36, colored male hotel porter, was stabbed in the left chest with a knife used for paring vegetables. The wound was approximately over the left third interspace about 4 cm. from the midline. He was brought to the office of one of us (T. P. W.) within half an hour. There was slight bleeding from the entrance wound, the pulse could not be felt at the wrist and the heart sounds were faint and rapid. The patient was quiet and unconscious.

Consultation was held at once and operation was done as soon as the patient could be removed to a hospital. Under light ether anesthesia a window opening was made by cutting the third, fourth and fifth ribs with a shear and the costal cartilages with a knife, the skin and muscle having been reflected. There was a wound in the lung which was not bleeding, as the lung was collapsed. The heart was well exposed and a half inch wound found in the right auricle. (Figs. 1 and 2.) There was a steady stream of blood flowing from the wound and a large amount of blood, mostly clotted, in the left pleural space. The movements of the heart and lungs became tumultous following the administration of epinephrine and production of pneumothorax. The lung movements were partly controlled by packing gauze about the lung. A finger laid over the wound in the auricle controlled the bleeding while fine silk sutures were passed and tied. The pericardial wound was but slightly larger than that in the auricle and was also closed with silk sutures. There was no tamponade. Blood clots were scooped from the chest with the hand and the remainder of the blood removed by sponging. The wound was closed in layers and a small rubber drain put in. Morphine and fluids were administered as necessary. The patient did well until signs and symptoms of empyema developed at the end of two weeks. The empyema was drained through a stab wound and when this healed without undue complications the patient was discharged in good condition and returned to his work. Operation was done on March 12, 1938. The patient has remained in good condition.

CONCLUSIONS

That death did not occur from hemorrhage seems due to the fact that the pressure in the auricle was comparatively low. There was a much diminished cardiac output because of the break in continuity of the blood stream passing through the heart chambers, the loss of blood from the auricle, and a disturbance in the sucking pressure normally exerted upon the venous gateway to the heart. This last doubtless allowed a damming back of blood in the venous system so that the patient suffered from both hemorrhage and relative cerebral anoxia. This case illustrates the wisdom of prompt operation even though the prognosis seems hopeless.

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OPERATIONS ON THE PHRENIC NERVE

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SURGICAL procedures performed upon the phrenic nerve are always for the purpose of paralyzing the corresponding hemidiaphragm. The type of operation performed is dependent upon the length of time for which paralysis is desired. This in turn is dependent upon the indications for the procedure.

Indications. Paralysis of a hemidiaphragm or occasionally of the entire diaphragm is desired in a variety of conditions. The use of the procedure in the treatment of pulmonary tuberculosis was widespread during the decade from 1925 to 1935. In recent years, the indications have narrowed considerably and today its use is exceedingly limited. Table 1 cites some of the more common usages for diaphragmatic paralysis. It is not the purpose of this paper to discuss the indications and contraindications for the procedure. For such information, reference must be made to standard works upon the subject.

Anatomy. The phrenic nerve arises from the fourth cervical nerve, usually receives branches from the fifth and occasionally from the third, and passes around the lateral border of the scalenus anticus muscle. It crosses the anterior surface of this muscle from without inward, deep to the transverse cervical vessels, passes along its mesial border behind the clavicle and between the subclavian artery and vein into the thorax. Within the thorax, it passes downward through the middle mediastinum alongside the pericardium to the diaphragm, where it divides into branches supplying the various parts of this muscle.

The variations in the origin of the phrenic nerve are of great importance in its surgery. The percentage of cases in which it arises from more than one cervical nerve is so great that these branches must be looked for and cut if one is to expect a complete paralysis. The most common accessory branch is from the fifth cervical root, which should always be carefully examined if complete avulsion of the nerve is not performed. Unilateral, double, triple and even quintuple nerves have been described, as well as slings around the internal mammary, transverse cervical and subclavian vessels. The nerve has even been described as passing through the subclavian vein, or buried in its wall. Fortunately, most of the accessories are not too intimately connected with blood vessels and join the main trunk within a distance of 11 to 13 cm. from the level at which it crosses the scalenus anticus. Therefore, if avulsion of the nerve is performed and at least 13 cm. are removed, one may be confident that a total and permanent paralysis of the hemidiaphragm will ensue. Anastomoses with the subclavian and suprascapular nerves as well as the ansa hypoglossi have been described.

The phrenic nerve may cross the scalenus anticus muscle in an almost horizontal position either high up near its origin or low down near the clavicle. If not found in its usual position, it should be sought laterally near the cervical plexus or medially between the medial border of the muscle and the internal jugular vein. The size of the main nerve is a fair indication of the presence or absence of important accessories; a small phrenic nerve usually indicates large accessories.

The phrenic nerve is the sole motor nerve to its corresponding hemidiaphragm. Interruption of its nerve impulses causes immediate paralysis of the muscle with atrophy which begins in a few weeks and progresses until it becomes complete about the third or fourth month. Paralysis of the

diaphragm is usually accompanied by an elevation in its position and by paradoxical motion, i.e., it descends during expiration and rises during inspiration.

be used; any anesthesia which does not provide for the return of consciousness within a few minutes after the conclusion of the operation should be avoided.

TABLE I

INDICATIONS FOR DIAPHRAGMATIC PARALYSIS

Treatment of Pulmonary Tuberculosis	As an Independent Procedure	In early cases as aid to bed rest; for small, fresh, thin-walled cavities; for cavities near hilus or in lower lobe; for hemoptysis; for pain from diaphragmatic adhesions; to aid in reexpansion of lung in presence of pleural infection.
	As Aid to Other Collapse Procedures	In some types of ineffectual pneumothorax; at discontinuation of pneumothorax; to aid in closing empyema cavities in conjunction with thoracoplasty; in conjunction with scaleniotomy or anterolateral thoracoplasty (Monaldi); in conjunction with intercostal neurectomy or pneumoperitoneum.
Treatment of Nontuberculous Diseases	As Aid in Major Thoracic Operations	Pneumonectomy, lobectomy, herniation and wounds of diaphragm, etc. (Nerve exposed within the thorax.)
	Spasm of Tetanus, Encephalitic Tic, Intractable Hiccough	
	Diaphragmatic Hernia	Small para-esophageal type
		Large hernia in which operation is contraindicated
	Bronchiectasis, Lung Abscess, Pulmonary Suppuration	
	Hemoptysis	
	Basal Empyema Cavities	
	To Increase Volume of Abdominal Cavity before Operations for Huge Scrotal or Umbilical Hernias	

TABLE II

TYPES OF OPERATIONS

Transient Paralysis—Novocaine Injection		Without skin incision
		Nerve exposed
Temporary Paralysis	1–3 Months—Freezing with Carbon Dioxide Snow or Ethyl Chloride	
	4–8 Months	Phrenemphraxis (crushing)
		Alcohol Injection
		Simply Phrenicotomy (cutting with approximations of ends)
	10–12 Months—Crushing with Partial Extraction (Frank)	
Permanent Paralysis	Phrenicectomy (phrenic neurectomy-avulsion)	
	Radical Phrenicotomy (Goetze)	

Types of Operation. The various types of operations which may be performed upon the phrenic nerve in order to obtain a paralysis of the diaphragm are given in Table II. It must be remembered that in a small percentage of "temporary paralysis" procedures, a permanent paralysis may occur; likewise a small number of "permanently paralyzed" diaphragms may have return of function.

TECHNIC

The patient lies on his back with a small pillow under the shoulders in order to extend the neck slightly. In patients with copious sputum, a moderate Trendelenburg position should be used. The head is kept in the midline but turned away from the side to be operated upon. Local infiltration is the anesthesia of choice. In children who cannot be controlled, a light narcosis may

After ordinary skin antisepsis, the field of operation is draped, leaving the nose and mouth free. The posterior border of the clavicular portion of the sternomastoid muscle is found by having the patient raise his head. If possible, the course of the external jugular vein is noted. The incision should lie between these two landmarks and be situated about 2 cm. above and parallel to the clavicle. Until the surgeon has performed a number of phrenic nerve operations, it is advisable for him to use a somewhat larger incision, extending it slightly mesially over the sternomastoid muscle and also more laterally. This may necessitate tying off the external jugular vein. The type of operation determines the length of the incision. For an avulsion, a smaller incision will suffice because there is usually no need to search for accessory branches. The above described incision is

the one most commonly used, although Lilienthal has advocated an incision upon the clavicle, and others have used a vertical incision along the lateral margin of the sternomastoid.

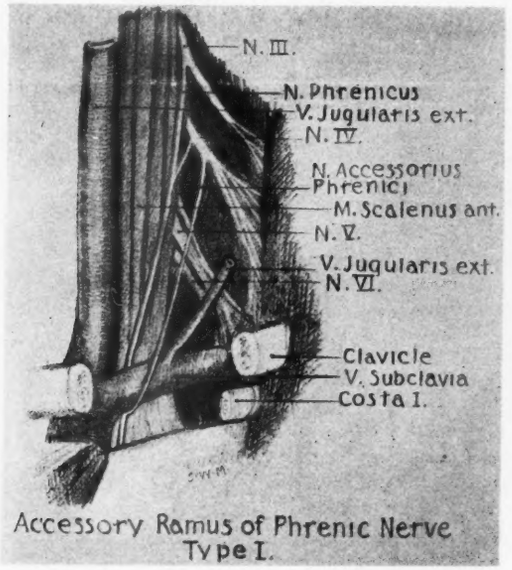

Fig. 1. Accessory ramus of the phrenic nerve derived from the third or fourth cervical nerve and taking a vertical course. (*J. Thoracic Surg.*, 2: 538, 1933.)

Only the skin and subcutaneous tissues need be anesthetized. Any deeper injections are dangerous due to the proximity of important structures. The incision should be placed in a natural skin crease and should be planned before the skin is distorted by novocaine injection. After incision of the skin, subcutaneous tissue, platysma muscle and superficial layer of the deep cervical fascia, the lateral border of the clavicular portion of the sternomastoid comes into view. When this is retracted medially, a fat pad overlying the scalenus anticus muscle is exposed. For safety, sharp pronged retractors should never be used. Delaney has designed a special phrenicectomy retractor for use in small incisions. The fat pad on the scalenus is either teased apart or separated by blunt dissection with Mayo scissors or hemostat. Beneath this layer of fat, the anterior surface of the scalenus anticus muscle will come into view with the brachial plexus lateral to it.

The deep layer of the deep cervical fascia covers the scalenus anticus and the nerve roots; and if the phrenic is in its normal position, it can be seen through this fascial layer, lying upon the anterior surface of the muscle. This layer of fascia is then incised and the nerve exposed. Its normal size is about that of the lead in a pencil. If a phrenicectomy is to be performed, no further dissection is necessary. The nerve is isolated and 1 per cent novocaine injected into its sheath. Complete anesthesia does not occur for about two minutes and no manipulation of the nerve should be done until it is absolutely painless. The nerve is grasped with a hemostat and sectioned as high as possible. Using a steady uniform force, the surgeon slowly winds the nerve around the forceps in windlass fashion. Washburn and Proctor have devised forceps with a flange at the end in order to prevent the nerve from slipping during the avulsion. If there is severe pain in the chest, the procedure is stopped for a few moments. It is advisable to apply a second forceps lower down to prevent retraction into the thorax should the nerve break. Suddenly, the thoracic attachments will give way and a varying length of nerve will be extracted. If 13 or more cm. are avulsed, no further operative procedure is necessary, because, ordinarily, the accessories

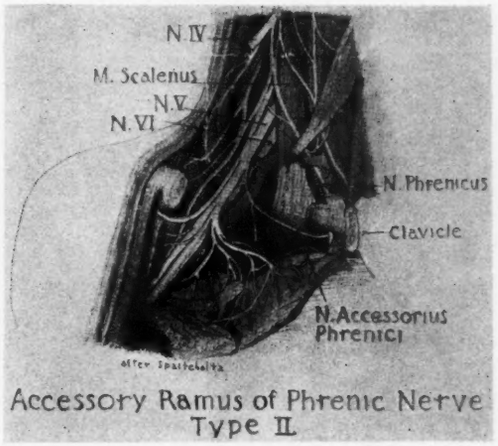

Fig. 2. Accessory ramus of the phrenic nerve derived from the fifth cervical nerve and taking a horizontal course. (*J. Thoracic Surg.*, 2: 538, 1933.)

join the main trunk within this distance from the point of exposure. If, as occasionally occurs, a shorter piece has broken off, it is advisable to search for accessory nerves and resect them.

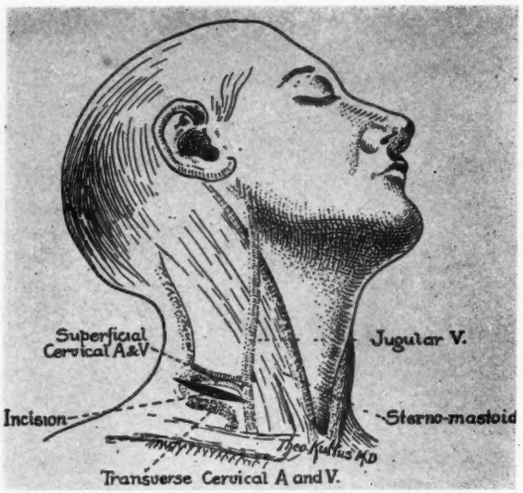

Fig. 3. Site of incision through the skin showing relations to deeper structures. (*Illinois M. J.*, August, 1932.)

If the phrenic nerve is not found in its usual position, crossing the scalenus anticus, it must be searched for along the lateral or medial border of this muscle. When exposing the internal border, care must be taken to avoid injury to the internal jugular vein and the vagus or cervical sympathetic nerves. The phrenic nerve may be best identified by tracing it upward to its point of origin from its cervical nerve root. Pinching of the phrenic nerve will usually elicit pain in the anterior part of the shoulder. Broga has advocated electrical stimulation which will produce a hiccup or a prolonged inspiration.

If the phrenic nerve is not found either on the anterior surface or medial side of the anticus, it should be sought along the lateral edge where it must be differentiated from cervical and brachial plexus nerves. If not identified in any of these locations, the fibers of the scalenus anticus muscle should be separated, for the phrenic nerve has rarely been found in the muscle bundle.

When the phrenic nerve has been definitely identified and a permanent paralysis is desired, either an avulsion, as previously described, is performed, or a radical phrenicotomy. (Goetze.) For the latter procedure, a slightly larger incision may be necessary. The nerve is followed to both

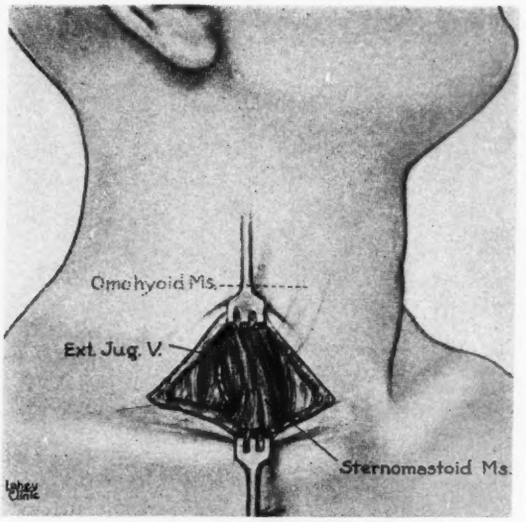

Fig. 4. Skin edges retracted showing sternomastoid and external jugular vein. (*Surg. Clin. N. America*, December, 1935.)

ends of the exposed area and any filaments or branches joining it are severed. The fifth cervical nerve should be exposed, and an accessory nerve running from it to join the phrenic nerve lower down should be sought. If found, this branch should be removed and then at least 2 to 3 cm. of the main phrenic nerve resected. This method, as advocated by Goetze, will give as high a percentage of effective permanent paralyses as phrenicectomy, with less hazards.

If only temporary paralysis is desired, the nerve is isolated from the surrounding tissues by packings, anesthetized and either thoroughly injected with absolute alcohol for a distance of 2 to 3 cm. or frozen with ethyl chloride or carbon dioxide snow. In order to assure a complete paralysis, the accessories should be exposed and resected, as in the Goetze method.

When simply phrenicotomy is done, the nerve is anesthetized, cut across and the ends approximated with fine silk sutures. When phrenemphraxis (crushing) is performed, at least 1 cm. of nerve should be crushed and care must be taken that all the nerve fibers have been caught in the serrations of the instrument. Special crushing forceps have been devised with the

serrations so arranged that complete crushing will result. With both phrenemphraxis and phrenicotomy, the accessories must be divided to insure complete diaphragmatic paralysis.

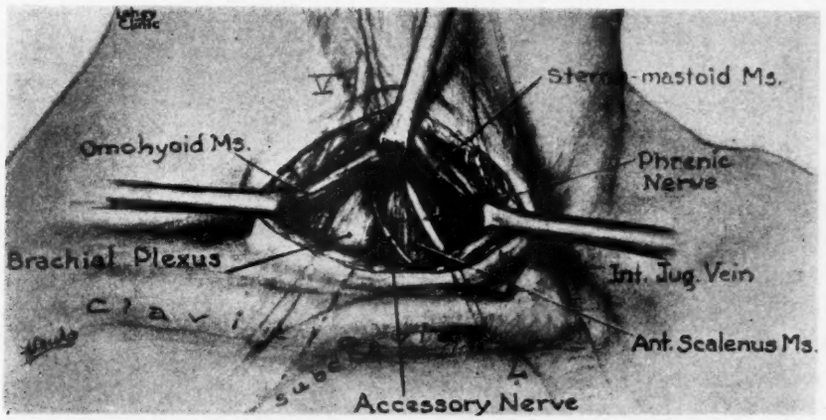

Fig. 5. Exposure of the phrenic nerve below the omohyoid muscle. (*Surg. Clin. N. America*, December, 1935.)

Some advocate tying a piece of fine silk loosely around the nerve and attaching this suture to the platysma in the wound. This may aid in locating the nerve, should a secondary operation be required. On the other hand, if the exact position of the nerve is described in the operative report, it is not difficult to find the nerve at a second or third operation.

Closure of the wound is simple: a few fine catgut sutures to the platysma, and either fine silk or clips to the skin. A subcuticular suture may be used if desired. If the incision has been placed in a natural skin crease, it will soon be practically invisible.

Complications. A survey of the anatomy of the operative area involved will give a strong hint as to the complications which may occur at the time of operation. Injuries to every structure in the region have been reported: tears of the internal or external jugular veins, with air emboli; hemorrhage from subclavian vessels, injuries to brachial plexus, cervical sympathetic and recurrent laryngeal nerves and thoracic duct. During avulsion, pleural tears may occur, as well as hemorrhage from the pericardiophrenic artery or vessels which have been encircled by accessory nerves.

Patients with large amounts of sputum from disease of the lower lobe may be suffocated immediately after operation by the expulsion of these secretions into the bronchial tree. Those with diminished respiratory surface may have marked dyspnea due to pressure of an elevated diaphragm upon the lower lobe plus absence of the normal diaphragmatic movement.

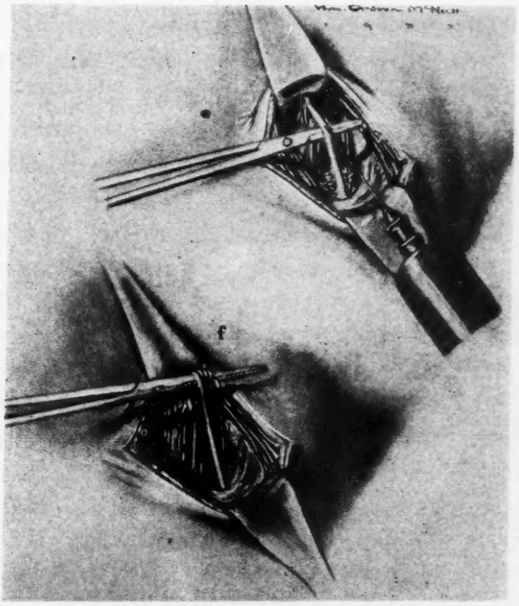

Fig. 6. *e*, method for infiltrating the nerve before avulsing or cutting it. *f*, technic of avulsion. (*Surg. Clin. N. America*, 12: 1579, 1932.)

Left-sided paralysis may be followed by gastrointestinal symptoms due to displacement of the stomach, duodenum and large colon. Cardiac symptoms have been

observed because of mediastinal displacement. In decompensated cardiac states, paralysis of the right side of the diaphragm may interfere greatly with the return of venous blood to the heart.

Tests for Diaphragmatic Paralysis. It is advisable to determine shortly after operation whether the procedure has been successful in paralyzing the diaphragm. This must be done by fluoroscopy. The elevation of the hemidiaphragm may not occur at once. Diaphragmatic movement on the operated side may be entirely absent or it may be paradoxical, i.e., downward upon expiration and upward upon inspiration. This may be accentuated by the Bittdorf test. With the lips and nostrils tightly closed, the patient is instructed to inspire deeply. This causes a marked increase in the negative intrathoracic pressure and results in an exaggerated paradoxical rise of the flaccid hemidiaphragm.

When a pleural effusion or marked pleural thickening is present, the diaphragm may not be clearly visualized. Under these circumstances it may not be possible to determine definitely whether paralysis has been achieved.

Although the exposure of the phrenic nerve in the cervical region may be classed as a minor operative procedure, nevertheless, it should not be attempted by anyone but a qualified surgeon. The field of operation contains many important structures whose injury may lead to serious complications. A thorough knowledge of both the normal anatomy of the region and the variations which may occur is necessary. If this knowledge is combined with good surgical technic and careful anatomic dissection, complications will be minimized and good operative results obtained.

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A NEW TREATMENT OF GANGLION

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FOR many years the treatment of ganglion has gone on unchanged, receiving as a rule, a non-surgical handling with no assurance the condition would not readily recur. Surgical removal has offered a difficult and hazardous procedure for such a benign condition.

A ganglion is a cystic formation which occurs on the capsular ligament of an extremity. It may follow strains and injuries and is most commonly found on the dorsal surface of the wrist but may be found about any articular surface. (At one time ganglia were supposed to be hernias of the synovial sheaths.)

Pathology. Sections show that these cysts develop within the capsular ligament and not in the sheath. An obliterative endarteritis of traumatic origin is the cause of the nutritional disturbances which precede the degenerative changes. At first several small cysts occur which later unite and form a larger one. They usually communicate with the articular surface.

Diagnosis. The localized swelling may be the only symptom, or weakness of the joint and in some instances quite severe neuralgic pains may be associated. The swellings are so characteristic in appearance that there is usually no difficulty in making a diagnosis. Lipomas, fibromas, gliomas, encapsulated foreign bodies, fragmented fractures and myositis ossificans may offer differential diagnostic problems.

Treatment. Previously treatment has consisted largely of rupturing the cyst by external force while the part was tense. Complete dissection is difficult and recurrence often occurs. The dangers of entering a joint for such a benign tumor are excessive. The injection of strong sclerosing fluids is dangerous and has largely been abandoned.

The new treatment consists of injecting a proteolytic enzyme (caroid) into the cyst and allowing this substance to remain within the cyst for several minutes. This enzyme liquefies the gelatinous material which can then be freely aspirated.

Technique. The skin is prepared surgically. Novocaine may be used to infiltrate the skin over the ganglion, but this is not essential if a sharp needle is used.

The solution used is a suspension of pulverized enzyme (caroid) in sterile distilled water, 1 dram of enzyme to each 5 c.c. of distilled water. One minim of hydrochloric acid is added to each 10 c.c. of suspension. This mixture is shaken vigorously and drawn into a 10 c.c. syringe fitted with a 20 gauge needle.

The ganglion is tensed, the needle inserted and under steady pressure the suspension is injected slowly into the ganglion. About three minutes should be used in injecting each c.c. Usually 2 c.c. of the suspension is sufficient, but this, of course, depends on the size of the ganglion.

In thirty minutes liquefaction is completed. However, the solution may be allowed to remain twenty-four hours without causing any distress and the patient may return the following day for aspiration. The ganglion may then be aspirated freely and the collapsed cyst irrigated with distilled water without removing the needle. A light pressure dressing is applied.

It has been found that this suspension also tends to destroy the secretory action of the walls of the ganglion so that recurrence is rare. However, if desired, a few drops of a solution of 10 per cent sodium morrhuate may be injected into the ganglion to act as a sclerosing agent.

A mild reaction may be evidenced by a slight stiffness and soreness, but these have

proved of mild nature and disappear in twenty-four to forty-eight hours. Hot applications alleviate this mild condition. No other complication has occurred.

SUMMARY

Previous methods of treating ganglia have been unsatisfactory or of undue risk because of the difficulty of excising the cyst completely. A new method of treatment is presented based upon the proteolytic liquefaction of the gelatinous substance contained within the ganglion and its subsequent aspiration. This method is practical, atraumatic, and is a simple and safe procedure.

A GANGLION is the term given to a localized cyst-like swelling forming in connection with a tendon sheath or joint. . . . It varies in size considerably, and contains a clear, transparent, gelatinous or colloid substance.
From—"Rose & Carless Manual of Surgery," Edited by William T. Coughlin (The Williams & Wilkins Company).

POSTOPERATIVE CARE TO RESTORE NORMAL PHYSIOLOGY

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THE elimination of drastic preoperative purgation and starvation, except by a few of our older surgeons, has removed the discomfort to which the patient was previously subjected before operation. Developments in anesthesia and the judicious use of the opiates and barbiturates have rendered the apprehension and pain of the operative day practically non-existent. Postoperative comfort has also definitely improved, but even today, the patient fears the postoperative period with its gas pains, enemas, colonics, and its period of starvation.

While surgical resident in the American Hospital of Paris, I observed that most postoperative patients were more comfortable, did not become so distended and did not complain of gas pains so much, as patients previously observed in this country. The American Hospital patients on one surgical service (de Martel) after appendectomy were never given enemas. On the other service (Du Bouchet), enemas were not given before the third postoperative day. The comfort of these patients was very convincing and the benefits of restraint in the use of postoperative enemas obvious.

These experiences stimulated me to closer observation of the postoperative course and care of patients in an attempt to eliminate as much as possible the discomfort of the postoperative period.

The condition of the gastrointestinal tract following surgery is influenced by several quite variable factors: (1) *The particular operation involved.* A pelvic operation is not so shocking to the patient as an operation involving the gastrointestinal tract; a simple appendectomy not so severe as the removal of a gangrenous appendix. (2) *The surgeon himself.* One surgeon will produce twice as much trauma as another in doing exactly the same operation. (3) *The patient.* A young robust patient has far more resistance than an aged debilitated patient.

The definite pathologic physiology in the gastrointestinal tract following operation is as variable as the sum total of these three and other mutable factors. There is a noticeable reaction to every surgical operation, even with ideal conditions. The effect of trauma during operation is not localized to the area of the gut involved in the operation but affects the entire gastrointestinal tract. This all or none principle of the intestinal tract probably functions by way of the myenteric plexus. The trauma of operation through the sympathetic system causes an inhibition of the peristaltic movements of the wall of the gut and diminution of its tone along with a tight closing of the sphincters. All the normal gastrointestinal secretions are inhibited as the result of the anesthesia and the surgical procedure carried out.

It would seem that the ideal postoperative care would be that which would lead to a restoration of the normal physiology in the shortest time possible. Withholding food from these patients for three or four days certainly does not help, for it adds starvation to an already damaged body. The repeated administration of enemas to a patient who is not in condition to use his voluntary muscles to help expel them and whose intestinal peristalsis is inhibited and gut wall relaxed and already empty, is not physiologically helpful but actually abusive. This line of procedure increases the fertility of an already ideal field for the multiplication and proliferation of the bacterial flora normally found in the lower intestinal tract with associated gas forma-

tion. I feel that the usual postoperative care does not aid in the restoration of normal physiology but adds starvation, abuse, and increases gas formation in an already disturbed physiologic state and prolongs postoperative recovery.

For the past four years I have as a general rule followed a postoperative plan quite different from that usually encountered. The basic features of this plan are: (1) early feeding; (2) elimination or late use of enemas; and (3) early bed activity of the patient.

Reversed peristalsis and, occasionally, vomiting have been observed in the empty gastrointestinal tract of a normal person. One would expect that nausea and vomiting would be more frequent with the effects of the trauma of an operation added to the existence of an already empty intestinal tract. I believe that lack of food in the stomach has a definite bearing in some cases of postoperative vomiting. Thomas[1] has observed that vomiting in dogs which had been operated upon often stopped after they were fed a normal meal. I have seen numerous cases where postoperative vomiting stopped promptly after the patient had taken some solid food. No physiologic reason has been discovered that would render postoperative feeding harmful, provided the food is retained and there is no specific contraindication such as definite operative interference on the gastrointestinal tract.

It is an established fact that food is the normal and best stimulant for the promotion of gastrointestinal secretions. These gastrointestinal secretions are the normal inhibitors of the growth of bacterial flora and, together with the mechanical action of the food, are the stimuli of normal peristalsis.

I, therefore, feed my patients solid food as soon as they are able to take it and retain it. Variable factors involved in various operations exert their influence, but practically every patient is given a tray of soft food the morning following operation. If he has recovered from nausea and vomiting after anesthesia, he is given food the evening of the day of operation. It is not expected that the patient will eat everything on the tray; most do not. If they eat a small amount, when time for the next tray comes around they will eat a little more and by the time the third or fourth postoperative day arrives these patients are consuming everything on the tray, with comfort and enjoyment, while the patient under the usual routine is uncomfortable and attempting to eat a bite or two from his first tray of solid food.

The soft food which is given the patient is the routine hospital tray usually made up from the following list of foods:

1. Cereals
2. Eggs
3. White meat of chicken
4. Bread or toast
5. Strained fruit
6. Macaroni
7. Baked or mashed potato
8. Sponge cake or vanilla wafers
9. Butter
10. Cream and cottage cheese
11. Eggnog
12. Custards
13. Soft deserts
14. Milk is not withheld

If a patient is able to take food the day of operation, he is usually given toast and jelly, cereal, junket, or ice cream. Occasionally, a patient fed the day of operation will vomit during the latter part of the evening, but as a rule very little, if any, of the food is discovered in the vomitus and in the morning he will eat willingly.

The occasional patient, usually a frail neurotic female, who will be found still vomiting or more likely gagging and retching twenty-four hours or more postoperatively and abhorring the thoughts of food, can be persuaded to eat a little ice cream. I have seen gagging stop almost miraculously after ice cream and the patients proceed to the soft food stage without further difficulty.

[1] Thomas, J. E. Personal communication.

Patients who have had partial gastrectomies or gastroenterostomies may have Levine tubes passed before closure of the abdomen. The operator can see that it is threaded 6 or 8 inches beyond the operative site and the patient can be fed predigested mixtures through the tube. It is often possible to give these patients enough liquid nourishment by way of the tube to maintain their water balance and thus avoid the use of intravenous infusions.

Patients fed early after operation are remarkably free from gas pains and distention. The degree to which they suffer from gas pains and distention on this routine depends to a great extent on the variable factors which we have previously mentioned. Practically every patient has some gas pains. Minor distention is not infrequent, but serious distention is rare. As a rule these conditions are at their worst about twenty-four to thirty-six hours after operation. If at this time the patient is not able to pass gas rectally of his own accord, a rectal tube is inserted and, in from four to eight hours, gas pains and distention disappear.

No further attention need be paid to the bowels till they move or until the fourth or fifth postoperative day. At this time if the bowels have not moved it is my practice to instil 2 ounces of mineral oil and 2 ounces of glycerin into the rectum slowly through a catheter, and a bowel movement usually results promptly. I do not claim any special therapeutic value for this combination, but believe that its effect lies in the mechanical stimulation of the rectum through distention.

It is also part of my practice to administer 1 ounce of mineral oil by mouth twice a day beginning the second or third postoperative day. Mineral oil has a value as a lubricant and aids in keeping the stool soft. Some patients are upset by it, while with others it seems to pass through the intestinal tract with no effect except for the constant leakage and associated soiling of linen. Some of the agar-mineral oil emulsions with or without cascara or phenolphthalein are therefore often used to better advantage. Regardless of the effects of these adjuvants in moving the bowels no direct attack is made on the bowel itself before the fourth or fifth postoperative day.

The third part of this plan consists in encouraging the patient to move about in bed as much as possible consistent with the pain caused by such movements. The more activity, the sooner the return to the normal physiologic status. Activity and use stimulate the normal physiologic functions while disuse encourages regression of functions.

Naturally the type of incision, the condition of the patient and the type of operation performed govern the question as to when the patient shall get out of bed. This question does not affect early bed activity. The patient is encouraged to roll from side to side in bed without the aid of a nurse, to use arms and legs freely and to take deep breathing exercises. Not only is early bed activity an aid in restoration of normal function, but the mechanical effect of activity helps to relieve the discomfort of postoperative gas pains.

CONCLUSIONS

This postoperative plan not only aids in a quicker restoration of normal physiologic function with a minimum of discomfort, but its effect on the patient is a major factor in the postoperative period. The mental attitude of any patient is often the barometer of his physical comfort. Patients receiving a liquid diet, which does not furnish enough calories for minimum basal requirements, and given repeated enemas and colonics, are often like a falling barometer, blowing up a mental storm which will tax the bedside manner of the ablest clinician. The mental attitude of patients fed solid food early and spared the increasing discomfort of repeated enemas presents the aspect of a rising barometer with bright and cheerful mental skies, which will also ease the mental strain of the attending surgeon.

I have found that the postoperative course of patients treated in this manner is

smoother and more comfortable and the morbidity period is shorter. Restraint has, however, been exercised in this presentation in an effort to set forth a logical analysis which it is hoped, will convince the reader of the advantages of this plan and encourage him to try it either in whole or in part.

SUMMARY

Customary postoperative care does not give the patient maximum comfort. Factors affecting the physiology of the gastrointestinal tract following operation, their modes of action, and their results are analyzed. Usual postoperative care aggravates the already impaired physiology. A plan of early feeding, restraint in the use of enemas, and early bed activity is outlined, which is helpful in restoring normal physiologic function.

The beneficial effects of this plan for both patient and surgeon make it worthy of trial.

Postoperative retention of urine is a common inconvenience after operations in this region; subcutaneous injection of esnodil will often relieve it.

From—"Rose & Carless Manual of Surgery," Edited by William T. Coughlin (The Williams & Wilkins Company).

LYMPHANGITIS AND LYMPHADENITIS*

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LYMPHANGITIS

THE name "lymphangitis" is commonly applied to that condition in which with some infection in the skin streaks of reddish or red and bluish discoloration are noted which extend along the extremity or part affected to the neighboring lymph nodes. Whether the term should be restricted to this type of infection only or to cellulitis as well may be a disputed question. Certainly in cases of cellulitis the local lymphatics are involved as they are in erysipelas and the erysipeloid infections. However, the name has been so commonly associated with that type of lesion described that we believe its identity as an entity should not be disturbed. One may see the condition associated with almost any type of infection of the extremities. A review of all cases seen at the Mayo Clinic during the years 1938 and 1939 reveals that a diagnosis of this condition was made in seventy-two cases during this period. The arm was involved in twenty-one cases and the leg was involved in fifty-one. In thirty-four of the fifty-one cases in which the lower extremity was involved trichophytosis was the most likely etiologic factor. This group of cases includes many in which the patients came to the Clinic on account of persistent swelling of one or both lower extremities and in many cases chronic lymphedema was developing. However, this condition is fairly frequently seen and so far as the development of chronic phases and persistent symptoms is concerned it probably is the most important of all types of lymphangitis.

Briefly, it should be recalled that the lymphatics are composed of a widespread network of capillaries which are found in the skin and subcutaneous tissues and empty into the tubular lymphatics which carry the lymph through into larger lymphatic veins which pass along the larger blood vessels to the thoracic duct, and thus into the venous circulation through the thoracic duct and the right lymphatic duct. This system of lymph capillaries is composed of a single layer of endothelial cells bathed in tissue fluids. Actually, many organs of the body have lymphatics and lymph circulation, but for our purposes here only the lymphatics of the subcutaneous tissues will be considered.

Lymph is composed essentially of the same materials as blood plasma but in a more dilute form. The chemical composition and cellular content may, however, vary greatly in pathologic conditions. The cellular content is about 95 per cent lymphocytes. The lymph contains all foreign materials carried away from the tissues. These foreign substances are apparently taken up by phagocytes but may also be carried along in the lymph stream by mechanical means.

Two factors are responsible for the propulsion of lymph through the lymph vessels: (1) contractions of skeletal muscles, and (2) pulsations transmitted through the arterioles. Thus, an important factor in treatment may be rest because of the reduced flow of lymph owing to inactivity of the skeletal muscles.

In reviewing the etiologic factors aside from trichophytosis we found that in cases in which an arm was involved the inciting causes were as follows: laceration in six cases, infection in six cases, carcinoma of the breast (with edema of arm) in four cases, lesions secondary to vaccination in one case, dermatitis venenata in one case, paronychia in one case, bite on finger in one case and abscess in one case.

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The group of inciting lesions in the lower extremity were, as indicated previously, predominated by the trichophytosis but the following conditions also were noted: blisters on heel in two cases, stasis ulcer and cellulitis in two cases, compound fracture in one case, arthritis of ankle and other conditions less clearly associated with the lesion.

Unfortunately, for any statistical value, cultures of the lesion were made in only six of the seventy-two cases and of these three showed no growth, two showed streptococci and one revealed Staphylococcus aureus. It is the prevailing impression that streptococci are usually the causative agent in these cases although most authors recognize that other organisms may be the cause.

The usual story is that following some minor scratch or cut the patient notes a moderate local swelling with stinging pain and then a sense of malaise with chills. Often, within the first twenty-four hours, the red streaks develop and tender swollen axillary or inguinal lymph nodes are noted, although the latter usually are noted a few hours later. In our series of cases chills were noted in twenty-five, malaise in twenty-three, nausea in six and headaches in four. Pain of a varying degree is always present.

The rapidity of the onset and the severity of the symptoms together with the obvious local changes and the streaking are so obvious to the patient and relatives that medical aid is sought at once, and it is this picture that in the layman's mind often indicates a "blood poisoning." Hence the patients usually are willing to submit to the obviously necessary treatment.

The condition is associated in the minds of many with severe reaction and often fatal outcome, but death occurred in only one case in our series. In this case the patient was a man, aged 77 years, who had been bitten on the hand by an insect a few days previous to onset. Local cellulitis and lymphangitis developed from which staphylococci were grown. Death in this case seemed to us to be due to senility and lack of resistance to a moderately severe infection. Blood cultures in this case were negative. In fact, no positive blood cultures were obtained in any of our cases of lymphangitis and it is our recollection that in spite of the often severe onset of the condition in many cases and the dramatically serious appearance of the patient, the response to adequate treatment is equally dramatic and subsidence of symptoms is fairly rapid under treatment properly carried out.

The end results in all but one of our cases were good. In many of the group of cases in which recurrent attacks of lymphangitis were associated with lymphedema, some permanent swelling was noted and this often had to be controlled by the wearing of rubber bandages and by elevation of the extremity for a period each day. In most of the cases in which the condition was acute and followed trauma, the condition responded satisfactorily and in most cases, quickly, to treatment.

Treatment in these cases should be undertaken only with the patient completely at rest in bed. As noted previously, much of the propulsive force behind lymph flow comes from the action of the skeletal muscles. With the patient and the affected part completely at rest, this force is reduced and the speed of lymph flow slowed down so that the spreading of infection is curbed. In addition it has been demonstrated by Drinker that the filtrative function of the regional lymph nodes is at its best with the part at rest. We usually apply hot or warm packs to the affected part and elevate the affected part. The hot packs are applied by wrapping the part in sterile, moist gauze and surrounding this with blankets wrung out of hot water and then surrounding the whole mass with a piece of oilcloth. These hot packs serve a dual purpose: (1) They furnish a penetrating heat, and (2) they act as a splint and prevent motion in the affected part. If an open wound exists, the

dressing next to the wound must, of course, be sterile. It is customary to cover the skin with a thin layer of petrolatum to prevent blistering, and care should always be taken to see that the dressing is not too hot. This is particularly important in cases in which the patients are unconscious or in cases in which there is some disturbance of sensation in the affected part.

In conjunction with the enforced rest and use of hot packs, it is important to give the patient plenty of fluid. Fluids should be by mouth or, if the patient is vomiting and cannot take them by mouth, 1000 cc. to 2000 cc. of physiologic saline solution should be given daily by the subcutaneous method. Sulfanilamide in doses of 80 to 120 grains (5.3 to 8 Gm.) per day should be administered and in many cases the use of roentgen therapy is beneficial. Light doses of roentgen rays in the early stages may do much to hasten the resolution of acute lymphangitis. We have observed subsidence within a very few hours after institution of such treatment.

In most cases the condition will subside within a few days with the combination of these therapeutic measures. Occasionally there may remain a region of cellulitis which results in an abscess which has to be drained, or occasionally a lymph node may suppurate and require drainage.

In some instances intolerance to sulfanilamide may be noted and its use must be discontinued. The usual precautions regarding blood counts and the concentration of sulfanilamide should be observed.

LYMPHADENITIS

The subject of lymphadenitis is a much more inclusive one than lymphangitis. In almost every instance of infection in an extremity, some degree of lymphadenitis may be found. It may be a very mild enlargement without pain or tenderness, as may be seen in any case of chronic low grade infection of the skin, such as a mild acneform infection. Indeed, regional lymphadenitis may be seen among persons whose skin is unclean and may be associated with such conditions as pediculosis. Besides all the variations of lymphadenitis, one sees chronic affections of the lymph nodes, such as tuberculosis, various types of granuloma, as well as numerous nonmalignant diseases and malignant disease of lymph nodes, both epitheliomatous and sarcomatous.

Differential diagnosis in the acute types of lymphadenitis is, as a rule, not difficult. The suddenness of onset and the accompanying regional infection often accompanied by lymphadenitis are enough to produce the clinical picture unless adenitis has been present before the infection, which might confuse the picture.

In cases of subacute and chronic lymphadenitis, however, a much more difficult problem in diagnosis may present itself. In such cases one may be dealing with a chronic lymphadenitis of inflammatory nature, with one of the lymphatic diseases such as lymphoblastoma or Hodgkin's disease, with metastatic involvement of the lymph nodes by a neoplastic lesion. The latter condition may be complicated owing to the fact that neoplastic lesions in these cases are often the site of a secondary infection which may in turn be transplanted to the regional lymph nodes so that a purely metastatic infection may be superimposed on a metastatic neoplastic lesion.

Thus, the diagnosis may be difficult and biopsy of one of the affected lymph nodes may be the only means of making an accurate diagnosis. Indeed, at times, this, too, is of doubtful value because a definite pathologic picture may not be present or the lymph node removed may not contain the pathologic lesion but merely may be the site of an inflammatory reaction. However, on the whole, it has proved a very satisfactory method of settling the diagnosis in many doubtful cases.

Treatment of lymphadenitis varies according to the type and stage of the disease. In those cases in which acute lymphadenitis is associated with lymphangitis we have been accustomed to use an ice cap

or ice pack over the lymph nodes to prevent further spread of the infection. This treatment seems to have been effective in most instances. If local swelling persists and is followed by softening and fluctuation, indicating suppuration of the lymph nodes, surgical drainage is necessary. At times, persistent swelling without softening may be reduced by the use of roentgen therapy. Suppuration may thus be hastened or the absorption of the inflammatory mass may be hastened.

SUMMARY

In the various types of lymphatic disease the use of roentgen therapy is recognized as the best type of treatment. In some cases the beneficial effects are only temporary and it is necessary to repeat the treatment from time to time. Many of these diseases are really neoplastic and in the long run their prognosis is uniformly bad.

Local metastatic lesions caused by malignant neoplasms may be treated by roentgen therapy as a palliative measure, but it must be recognized that the ultimate prognosis in such cases also is bad.

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FURUNCLES AND CARBUNCLES: PREVENTION OF GENERAL POSTOPERATIVE INFECTION

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AN apparently trivial furuncle, treated by incision, will usually heal without visible complication. But four weeks later, or six weeks later, when the boil may have been forgotten, abscesses of lungs, kidneys, or other organs may bring about a tragic termination. Investigating the course of the original lesion, one feels that incision directly through the indurated, infected skin may have brought about the sepsis. I have seen lung abscess, suppurative pneumonitis, or kidney abscess, so frequently following operations for furunculosis that I may be forgiven for this short paper, to call the matter to the attention of physicians, whether they are surgeons or in general practice. Dermatologists seem to be almost the only ones who are fully aware of this peril, and who treat even the smallest hardened, inflamed areas with respect. They reserve operation until the case has progressed to subcutaneous phlegmon, and only then advise open surgical drainage.

But however the attack is made, direct incision into the furuncle may produce emboli, because the veins, even the small ones, are held patulous by the rigid walls of the indurated skin and will carry tiny plugs of septic matter or bacteria only, in the direction of the blood current toward the heart, and thence to almost any part of the body.

There is danger, too, in making pressure upon the skin centripetal to the opening in a furuncle. If the focus of the boil is open and discharging, it is, of course, desirable to evacuate the necrotic tissue; but this can be done with greater safety by drawing the healthy skin *away from* the slough—or core, as it is popularly known. With two fingers on each side, the skin may be drawn radially away from the open boil with consequent extrusion of its contents.

Furuncles should usually be treated by a semicircular incision well outside the reddened area, through the normal skin as deep as the superficial fascia. The entire infected area is then dissected upward (preferably) and the boil is excised from within. The flap which formerly was the seat of the furuncle is then replaced over a thin gauze packing which may be withdrawn in two or three days. Healing is usually prompt and unaccompanied by pain. I have operated upon huge carbuncles of the neck by this method, once even extirpating a large one which began deep in the tissues, before there was any superficial redness. The wound was sutured and healed primarily, the diagnosis being confirmed by the pathologist.

The region of the nose and lips is especially a danger zone, because of the countless veins which discharge into the facial and thence into the internal jugular. Indeed, Lexer has advised preoperative ligation of the jugular in extensive indurated septic lesions of the face. In a general examination of the literature I have found a passage by Ayres, Anderson, and Foster[1] in which they state that they "have never observed serious complications in patients with lesions in this (face) area." This seems amazing to me, in view of the considerable number of fatalities which I myself have observed. It is pretty well confirmed in an editorial in the *Journal of the American Medical Association*[2] on the danger of indurated skin infections of the face.

The treatment of these boils or carbuncles of the face, especially those near the nose or in the upper lip, forms an

exception to the general technique, since they require incision through inflamed tissue in spite of the added risk. A method which I have used with success and have described,[3] is efficient and leaves a scarcely visible scar. A quotation follows:

"*Carbuncle of the Lip:* This extremely painful affection is remarkable for the great constitutional disturbance which it often occasions, as well as for the fact that it is actually dangerous to life, on account of its liability to cause thrombosis of the facial vein, which may extend to the deep jugular. There is always a tremendous degree of inflammatory edema, so that the lip becomes enormously distorted, while the rest of the face participates, and the corresponding eye is closed by the swelling. If the infection is in the upper lip, a brawny infiltration extends far up the cheek.

"*Operation:* General anesthesia is required. . . . Ignoring the pustular 'head' of the carbuncle, a generous incision should be made along the line of junction of the skin and the vermilion border, splitting the lip into two flaps by carrying the incision *completely through* the indurated tissues. Now holding the flaps apart with the sharp retractors, several layers of gauze should be passed with the aid of the probe to the bottom of the incision, and then, covering the wound and the lip with a pad of dry gauze, the dressing should be very firmly bandaged into place. There will be smart hemorrhage during this operation, but it is not usually necessary to tie any arteries except perhaps the coronary. The packing and the bandage will in most instances prevent serious bleeding. The dry dressing should be changed in six hours for a wet one. The packing may, if all goes well, be left in place for forty-eight hours. There is usually little or no trouble with the after-treatment of these cases, the large wound healing quickly."

We have here, to be sure, an exception to the method now recommended, but in view of the location of the disease it is mechanically unavoidable.

Out of many cases illustrating the subject of this article, I will abstract one which typifies what may happen following the incision of indurated skin abscesses, even small ones. The patient was one of my friends, a physician 32 years of age at the time (about twenty-nine years ago). He had two or three small, painful furuncles of the back of his neck on the left side. I made crucial incisions using local anesthesia, and there was apparently prompt recovery. About four weeks later, however, he became suddenly ill with fever, chills, and pain in both renal regions. I catheterized his ureters but found nothing abnormal. In spite of this negative finding I felt so sure that there was acute suppuration, probably in the cortices of the kidneys, that I performed right nephrotomy which yielded no information; nor did the operation seem to change the frightfully rapid course of his disease, and death came about thirty hours later. In those days, general roentgenologic diagnosis was not common, and I did not believe that *x*-ray examination would yield important information. At postmortem examination both lungs were found completely infiltrated with miliary abscesses, obviously the cause of death. Diagnosis of the pulmonary condition by the pathologist was "Staph-septicemia with furunculosis of the lungs."

To the wise ones who determine by a glance at the last paragraph whether or not to read a paper, let me say that this little article deals with the grave dangers which may follow the improper treatment of indurated acute inflammations of the skin exemplified by furuncles and carbuncles.

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BEDSORES

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IT would seem reasonable in such a presentation to take for granted a familiarity with the basic etiologic factors concerned in the development of bedsores, and also a familiarity with those methods of prophylactic and curative therapy that have been recognized as of value for generations. We will accordingly limit ourselves to the consideration of some of the measures, developed during approximately the last decade, which appear to offer distinct advantages either in the field of prophylaxis or in stimulation of healing.

The nursing care in a given case is of truly paramount importance because of the age of the patient, with attending decrease in skin resistance, or because of obesity, with the added weight and pressure factors, or again because of central nervous system involvement. Consideration of prophylactic measures should immediately be given most complete attention. These prophylactic measures concern chiefly the even distribution of pressure and the prevention of skin maceration.

The most important element in the nursing care of these patients with potential bedsores is the immediate institution of measures to secure even distribution of body pressure. The value of frequent change in position, of carefully inflated air rings and of "doughnuts" of cotton to take pressure from the bony prominences is recognized. There are a few instances, insofar as change in position is concerned, in which keeping the patient prone with considerable elevation of the hips and body by a number of soft pillows beneath the abdomen will promote healing of extensive ulceration over the posterior bony prominences.

The value of this position was well demonstrated in a patient who had had a gun-shot severance of the spinal cord at the fifth dorsal level, two and one-half years before coming under our care. In addition to the trophic factors, which contribute to the formation of bedsores, an infected pilonidal cyst had provided a starting point for an extensive skin slough. My predecessor on service had done an extensive excision, and in attempts to protect the very vulnerable sacral area, the patient had been kept in the lateral decubitus a considerable part of the time; but in the anesthetic, rigid extremities extensive pressure sores, had developed, and over the right lateral femoral condyle one had actually penetrated the capsule of the knee joint with a resultant pyoarthrosis.

The patient was emaciated, the temperature ran a septic course and the outlook appeared most unfavorable. Bilateral midthigh amputation was done. Rustless steel wire was used throughout for ligature and suture in order to reduce tissue irritation to the minimum. A large fraction of the infected areas was thus removed and prompt primary healing secured. We were then able to keep the patient in the prone position and prompt healing of the bedsores followed without the use of other measures than that of the cod-liver oil ointments. We believe that this emphasizes the fact that in such cord cases the factor of anesthesia, which prevents the pain-warning of prolonged pressure, is of greater importance than the trophic or nutritional factors.

Of greater importance, because applicable in all cases, is the question of the type of mattress employed, because no matter

what the position of the patient an even distribution of pressure is necessary. Air and water mattresses have advantages over those of textile construction; but the necessarily firm weave of the outer envelope prevents, in some instances, an accurate moulding over the bony prominences and fails to give an absolutely uniform distribution of pressure. Because of this we would call attention to the advantage of the sponge rubber type of mattress. The texture is such that accurate moulding to the bony irregularities and consequent even distribution of pressure is accomplished and, in addition, the usual slight movements of the patient produce changes in pressure which permit frequent capillary revascularization throughout the day.

For hospital use this type of mattress is said to possess the added advantage of greater durability, and in contrast to the ordinary mattress can be put through the laundry for cleansing. The experience at the Philadelphia General Hospital has been so satisfactory that the Directress of Nursing states that she is looking forward to the time when sponge rubber mattresses will completely displace all others throughout the institution.

The other important problem in prophylactic nursing is the prevention of skin maceration and the accompanying increased susceptibility to the entrance of infection. Maceration depending on excessive sweating is to be treated with bathing, change of linen, the use of skin massage with various rubs having an alcohol base and perhaps the occasional necessity of therapeutic control. By far the more important skin damage comes from incontinence, and fortunately the dangers from this source can now be controlled to a large extent.

With the improvement in catheter construction, the Foley particularly, an inlying catheter can be installed easily, will aid in preventing skin maceration and will materially lessen the burden of nursing. The question of danger of infection of the bladder may be raised, but the risk of this complication can be minimized by the simultaneous use of one of the urinary bacteriostatics.

For the male cord case with overflow of retention of "automatic bladder," such as was present in the patient cited earlier, a simple contrivance can be used to carry away the recurrent urine discharge. A piece of rubber tubing secured by ligature or rubber band to a perforated condom will, when the condom is applied and secured to the penis, prove to be a very satisfactory urine conductor and will not prevent the usual mobility of the patient.

Continuation of the above types of prophylactic measures is necessary throughout the patient's illness; but with the advent of indications of inevitable breakdown of the skin, or if the bedsore be actually present when the patient is first seen, active local therapy is also necessary. This local treatment varies with the extent of tissue damage and with the type of ulcer infection present.

The active treatment of bedsores may be grouped under the following headings: (1) local protective therapy; (2) local measures to control infection; (3) local measures to promote granulation and epithelialization; and (4) systemic measures to stimulate healing.

With the patient under careful observation from the onset of illness, a change in prognosis from threatened ulceration to inevitable ulceration is based on the failure of finger pressure on the discolored skin to produce blanching. The lack of blanching indicates capillary thrombosis and therefore maximal impairment of local nutrition. An early break in the skin is inevitable, bacterial invasion commonly soon follows and a rapid spread of the sloughing process may ensue.

In the early superficial areas of abrasion with minimal infection, tannic acid, as used in burns, has proved a very valuable addition to our therapy.

For securing satisfactory protection with this agent the essentials are few: (1) The frequent application (half hour intervals)

of 5 per cent to 10 per cent aqueous solution of tannic acid; (2) the constant exposure of the part to the drying effect of an electric light, under a suitable cradle, until a thick layer of tanned tissue is produced. Should infection develop beneath this coagulum the thick layer must be removed, and the area treated with wet dressing, such as Burow's solution 1:5 or 1:10, until the infection is brought under control, when the tannic acid treatment should again be resumed.

Latimer,[1] Fantus[2] and Spiesman[3] give reports of very satisfactory results following the above technic.

Where the ulcerative process is found to be somewhat deeper, but not rapidly spreading because of the presence of a virulent infection, the protective use of elastic adhesive as suggested by Carty,[4] and subsequently endorsed by Cope,[5] has proved valuable.

Elastic adhesive plaster of sufficient size to cover the open area and the surrounding skin to the distance of one inch is applied in double thickness; or if the area is too large for the width of adhesive at hand, the latter can be overlapped to secure coverage of the area designated. The adhesive is replaced only when it has become loosened and the only treatment applied at such changes is the gentle wiping away of the discharges. By the use of a double layer of adhesive the entrance of contaminating discharges is prevented, and it has been claimed that the retained wound discharges act temporarily as a fluid cushion distributing pressure.

In the presence of a recognizably active infection, as evidenced by progressive enlargement of the area of slough with tissue undermining and skin perforation, it is well to give consideration to the possibility of infection with the micro-aërophylic hemolytic streptococcus described by Meleney.[6] It is desirable to use culture methods to recognize or to exclude the presence of this organism; but if reliable culture technic is not available, I believe the use of zinc peroxide is advisable either (1) as a cream made up in sterile, distilled water, (2) as a 1 per cent suspension in gelatin or (3) in a 5 per cent pyrophosphate solution. Liberation of oxygen from this chemical in the presence of wound secretions continues over a prolonged period; and experimental and wound culture work has demonstrated the disappearance of other micro-aërophylic organisms from contaminated fields following the use of zinc peroxide.

With improvement in the patient's general condition, natural reparative forces are usually sufficient to effect progressive closure of the ulcerated area. Unfortunately, however, such is not the invariable rule and an open area exposed to repeated local infection, because of the absence of a vigorous granulation layer, may remain stationary or slowly enlarge and prove to be a source of systemic infection; or because of harassing pain it may prevent sleep, break the patient's morale and keep him bedridden over a prolonged period.

Under these circumstances the question is raised concerning the value of chemicals used for the specific purpose of stimulating granulation and epithelialization. Without experimental evidence of individual specific value, much of the local therapy in use for generations has been based on clinical observations which led to the belief of the presence of such cellular stimulating ability. With the primary reports of Reiman on the cellular stimulating effects of the sulphydryl radical on tissue growths, attention was directed to the use of sulphydryl preparations in the type of cases under consideration. Brunsting and Simonsin[7] reported on the use of .5 per cent crysteine in equal parts of normal saline and distilled water. The chemical is somewhat irritating to the exposed skin and intermittent application is often desirable. A regimen of alternating two day applications of the cysteine and two day applications of a bland treatment has proved satisfactory. Reiman had reported on the use of parathiocresol in his work, and, according to Klander, had recommended the use of .25 per cent of this chemical in anhydrous wool

fat, applied three times weekly in instances of delayed healing. The odor of this preparation had been objectionable, and the search for a satisfactory, but less annoying, sulphydryl preparation had resulted in the use by Brunstin and Simonsin of cysteine as reported. In a discussion of this paper J. H. Stokes spoke as follows: "I wish to commend the sulphydryl preparations in the treatment of bedsores. They are capable of transforming the misery to which these patients are subjected into comparative comfort. I have in mind particularly the spinal paralytic bed-sores. A patient who had almost sloughed away his entire sacral area was relieved of pain and obtained a marvelous effect from it on the bed-sores. The cheaper preparations in spite of their bad odor in the mass, can be handled by skillful packing and attention as to avoid this odor objection and the tendency to skin irritation."

A final measure of growth stimulation is obtainable through the general metabolic response to insulin. Joseph[8] has reported very favorably on the local response, where, despite recognized methods of treatment reparative processes were at a standstill. He advocates five to ten unit doses of insulin t.i.d. and reports cases favorably influenced where the necrotic process was deep.

SUMMARY

(1) Prophylaxis by prompt and effectual measures to secure equal distribution of pressure—sponge rubber mattress; (2) prophylaxis by prevention of skin maceration —inlying catherer and/or some type of drainage device; (3) active local therapy for the protection of the early superficially abraded surface—tannic acid as in burns; (4) local protection—by adhesive plaster strapping; (5) control of infection where active—zinc peroxide; (6) local stimulation—sulphydryl therapy; and (7) general metabolic stimulation—insulin.

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TECHNIC FOR INJECTION OF VARICOSE VEINS OF THE LOWER EXTREMITIES

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TO thrombose satisfactorily varicosities of the lower extremity, it is essential that sclerosing solutions be injected directly into the lumen of the offending vein. The technique which we are presenting has proved most valuable in our hands. Its main advantages are: (1) minimal likelihood of perivenous injection; (2) great stability of the needle; (3) good control of the content of the syringe; and (4) lowest possible incidence of failures.

FIG. 1. Relationship of patient to physician during therapeutic procedure.

Because almost every patient who undergoes this type of therapy is ambulatory, we recommend that he stand on a table or platform of a height at which the operator can work most comfortably from a sitting position. Acrophobia, due to the patient's elevated position, is usually overcome by his ability to grasp an adequate support suspended from the ceiling or placed at his side. With the patient standing in the elevated upright position in front of the surgeon, the varicosities, if patent, fill readily and an accurate survey can be made of their distribution. Observation alone in the examination of the patient does not suffice and it is our opinion that palpation is a valuable and dependable adjunct in determining the position and extent of the offending veins.

After the selection of the site at which the injection is to be made, the patient is turned around so that the vein is most accessible to the operator. The patient is further requested to make himself as comfortable as possible and to bear the greater portion of his weight on the extremity which is to be treated. This minimizes movement and adds stability to the vein in the subcutaneous tissues. The operator then usually assumes a comfortable sitting position directly opposite the site selected for treatment. (Fig. 1.)

The skin over the chosen region is cleansed with 1 per cent tincture of iodine or any mild antiseptic solution. For greatest facility, a syringe, preferably of a capacity of 2 or 5 c.c., and a sharp, short-beveled, 26 gauge needle are used. The syringe is held between the index and middle fingers, between the respective distal phalanges. The ulnar surfaces of the ring finger and little finger and, if convenient, the hypothenar surface of the hand are rested against the thigh or leg of the patient for greater stability. With its bevel facing the surface of the thigh or leg and parallel with the longitudinal axis of the vein, the needle is introduced intradermally adjacent to the

vein at an angle of approximately 20 degrees to the skin at that point. As soon as the point of the needle has passed through the skin, the plunger is withdrawn slightly to produce a negative pressure within the syringe. The thumb of the hand that holds the syringe is then pressed firmly against the barrel to hold the plunger in that position and thereby maintain the negative pressure. (Fig. 2.)

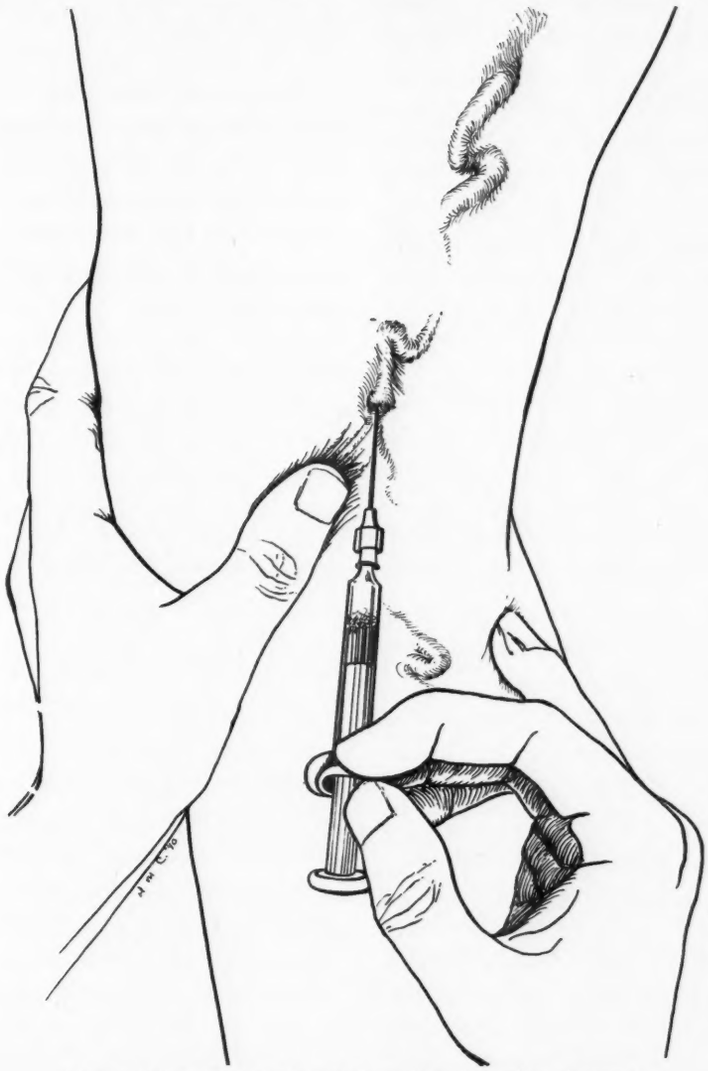

FIG. 2. Manual technic employed for injection therapy.

With the thumb and fingers of the other hand further stabilizing the tissues, the needle is then slowly advanced toward the vein. When the point of the needle passes through the wall of the varix, blood spurts into the syringe as a result of the negative pressure that has already been created. At this moment, the plunger is released in order to prevent further dilution of the content of the syringe with blood. If the position of the hand against the surface of the extremity is maintained as recommended, the constant relationship of the needle within the vein can be preserved even if the extremity of the patient should move unexpectedly. Throughout the injection, as a further precaution, withdrawal of small amounts of the content of the vein can be carried out at frequent intervals. If excessive pressure is needed to advance the plunger, if abnormal discomfort is experienced by the patient, or if slight swelling appears at the site of the injection, it is wise to discontinue the operation at once

and, at a later date, treat that particular region.

When the desired amount of sclerosing solution has been used, a small, sterile gauze pad is applied to the site of injection. The needle is then removed and moderate pressure is maintained by application of a strip of adhesive tape or by a bandage around the extremity. Thus, the walls of the vein are temporarily compressed to facilitate thrombosis and to avoid escape of the content of the vein as a result of the venipuncture. It should be remembered that only comparatively slight pressure is necessary to collapse a segment of superficial vein. The patient is advised to remove the gauze pad at the end of two hours, by which time it will have served its purpose.

This technique has proved dependable and satisfactory in dealing with all types and sizes of varicosities of the lower extremities. In occasional instances, some modifications are employed, although fundamentally, the procedure is carried out as described.

Correction: In our November issue, on page 336, Dr. H. C. Stein's address was given as White Plains. This should have read New York City.

VARICOSE VEINS AND ULCERS*

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At the present time, the management and treatment of varicose veins and ulcers has been very much simplified due to the better understanding of physical factors concerned in their production and the use of a more or less uniform type of treatment for their correction.

The injection treatment of varicose veins, now almost universally used, has reduced the period of disability to such a marked degree, that there is no question of its superiority over the methods of the past with their long periods of disability and economic loss. Almost all patients may be safely treated by the injection ambulatory method.

INDICATIONS AND CONTRAINDICATIONS FOR INJECTION TREATMENT

A careful history and physical examination, including pelvic and rectal investigation, should be made on every patient to ascertain the probable cause and mechanism in the production of the varicosities.

The *two absolute contra-indications*[1] to this type of treatment are acute phlebitis and the closure of deep veins by a previous thrombosis.

Varices present in cardiovascular and cardiorenal cases are on the border line.[2] In mild cases of decompensation, the treatment of large varices can serve only to aid the general circulatory condition. If the patient responds correctly to tests showing function of the deep venous circulation and if the circulation in the varicose veins is a reverse flow, treatment seems indicated. Varicosities of the saphenous system due to obstruction in the iliac veins or a blockade in the portal system of veins should be carefully evaluated before any treatment is instituted.

Treatment should be deferred in cases in which *pelvic tumor* is a factor in the production of varices until after such tumor has been removed. The complication of pregnancy[2] should not always be considered a contraindication, when the varices are painful or distressing due to size, particularly in the early months of pregnancy. However, no injection should be given after the seventh month of pregnancy. Painful vulvar varices of pregnancy are included in this group, and when seen about the fifth month respond well to treatment with the proper technic.

Varicosities associated with elephantiasis or in cases of massive edema of the lower extremity, should be considered very carefully. From personal experience, varices in this connection should be considered of secondary importance and treatment directed to the major condition.

TESTS USED IN THE EXAMINATION OF PATIENTS WITH VARICOSE VEINS

Anatomic studies show that the venous system of the lower extremity consists of a superficial and deep network of veins, which freely anastamose by a series of communicating branches. (Fig. 1.)

The superficial system of veins is composed of the internal or long saphenous vein, which drains chiefly the inner and anterior aspect of the lower extremity, and the short saphenous vein which collects blood from the outer and posterior aspect of the leg. The long saphenous vein enters the femoral vein by piercing the cribriform fascia covering the saphenous opening and the short saphenous vein joins the popliteal vein at the upper border of the popliteal space.

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The deep veins of the leg are situated below the deep fascia in the muscular and bony framework of the extremity. These deep venous channels, after collecting blood from the leg, unite to form the popliteal vein in the popliteal space.

All of these venous channels are equipped with valves to aid in the ascent of the venous blood, and to prevent retrograde flow. It is the impairment in function of these venous valves that lead to incompetence of the venous system of the lower extremity with resulting varicosities.

Much confusion seems to exist in the mind of the average individual concerning the interpretation of the various tests used in the examination of patients who have varicose veins, and for this reason, actual facts obtained from the literature and experience will be used to show what the various tests indicate.

The greater saphenous system, comprising the internal or long saphenous vein and its tributaries, should be examined first. The patient should be fully exposed from the groin downward and stand erect before the examiner. The degree of dilatation and the distribution of varicosities, the presence or absence of edema and skin changes are all noted.

To demonstrate incompetence of the greater saphenous system, a practical method has been described and illustrated by McCallig and Heyerdale,[3] "The fingers of one hand are placed over the great saphenous vein, usually at the fossa ovalis, while the fingers of the other hand percuss a dilated segment of vein in the leg below. The percussion stroke is an abrupt thrusting one, so as to give rise to an impulse. If the fingers at the fossa pick up a definite and strong impulse, incompetent valves and a dilated main saphenous trunk are strongly to be suspected. Proof may be established by a reversal of the procedure. If percussion of the vein at the fossa or in the upper portion of the thigh produces an impulse which travels downward to the fingers below and can be definitely felt, we know that the valves are incompetent and that the vein does not and never will perform its normal function. For such an impulse cannot travel distally in the veins if the valves are competent."

The lesser saphenous system should be examined in a similar way.

In cases where transmission of impulse is indefinite, by the above described method, or further confirmation of existing incompetence in the greater saphenous is desirable, the patient is placed in a recumbent position with the leg elevated to empty its veins. A tourniquet is applied on the uppermost portion of the thigh. The patient is then asked to stand, and if the veins fill rapidly from above downward after release of the tourniquet, the valves of the vein are not holding and the vein is incompetent. The lesser saphenous vein may be tested after the same fashion with the tourniquet applied just below the level of the popliteal space.

Incompetence of the communicating veins is usually associated with that of the greater saphenous system. The test described above to confirm incompetence of the greater saphenous system, will, therefore, give similar evidence regarding the communicating veins, by allowing the patient to stand *without* release of the tourniquet, rapid and immediate filling of varicosities of the superficial venous system give evidence of overflow from the deep venous circulation through incompetent communicating veins. To localize communicating vein incompetence more accurately,[4] tourniquets may be placed at different levels on the thigh and the degree to which veins are emptied by walking is evaluated. If the incompetent valves are at the saphenous opening, a tourniquet placed at the top of the thigh will allow fairly complete emptying of the leg veins on walking. If the lower communications are defective, there will be but partial emptying when the tourniquet is at the top of the thigh but more complete emptying when it is applied at the lower part. By estimating the degree to which veins are emptied with the tourniquet applied at different

levels, the exact spot at which the vein with the defective valve empties into the superficial system is identified.

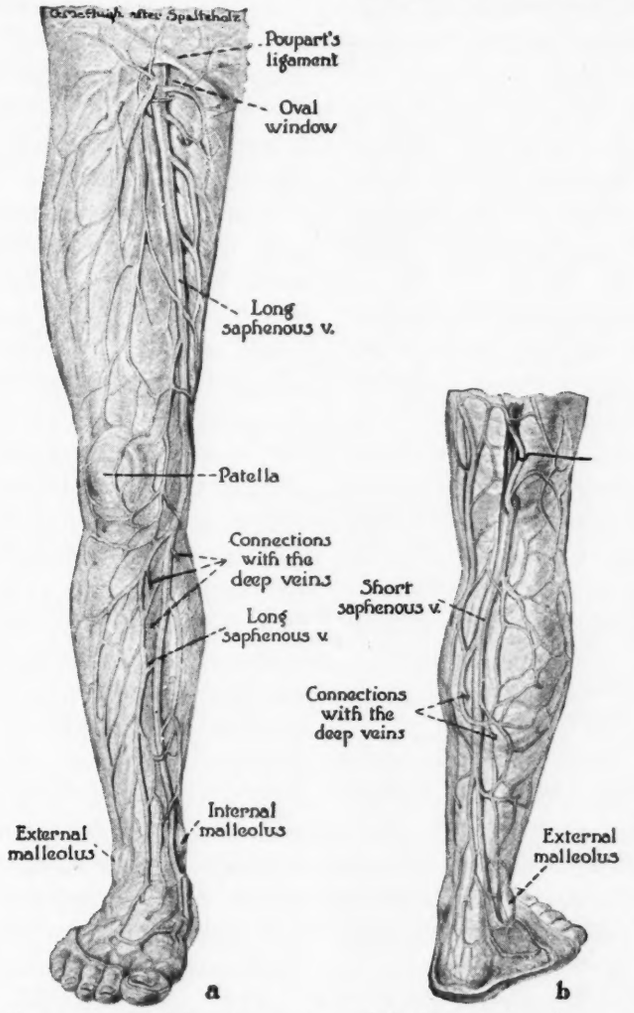

Fig. 1. Superficial venous system of the lower extremity. *a*, anterior view; *b*, posterior view. Both of these figures show the extensive communicating and branching of the superficial veins and easily explain the new formation of varicosities following the removal or obliteration of varicose segments here and there. Note the communicating veins throughout. (H. O. McPheeters and J. K. Anderson. *Injection Treatment of Varicose Veins and Hemorrhoids*, 2nd Ed. Philadelphia, F. A. Davis Company.)

In an evaluation of the *deep venous system*, the most important consideration is persistent occlusion. If edema is absent, one can almost exclude the possibility of complete blockage. The history will usually contain a story of phlebitis, with fever, tenderness and swelling of the leg.

To determine accurately the presence of thrombosis and occlusion of the deep venous system, a Para gum rubber bandage may be applied around the leg[3] from the instep to just above the knee, or as far up the thigh as indicated. The patient is instructed to walk about with the bandage in place and to note whether with this activity his discomfort is increased or diminished. If the flow through the venous system is a compensatory one, the constriction caused by the bandage will result in severe discomfort, because those veins which have assumed the function of allow-

ing a return flow of blood from the extremity are compressed. If the flow in the superficial veins is not compensatory, and if a block is not present in the deep circulation, the bandage will give relief by collapsing the useless superficial varicosities.

The injection of sclerosing agents in superficial veins acting as a detour mechanism from the deep circulation is contraindicated. Such treatment will only further retard the venous return from the lower extremity.

In a final analysis of the indications for injection treatment of varicose veins of the leg, it may be said that when it is established by reliable tests that the valves in the saphenous system are incompetent, it is safe to use sclerosing agents to reduce or obliterate the lumen of such veins, except in the presence of serious organic disease, the presence of acute phlebitis or when complete occlusion of the deep venous system exists.

TREATMENT OF VARICOSE VEINS

Experience shows that the method of combined high ligation, division and retrograde injection to be the method of choice in the treatment of varicosities of the saphenous system in the presence of demonstrable incompetence. When the varicosities are small and the saphenous system is competent, injection treatment alone is indicated.

Technic. The patient can usually be treated as an out-patient without preliminary sedation. The operative field should be shaved and ordinary methods of skin sterilization used. Under local anesthesia, using a 1 per cent solution of procain with adrenalin, a 3 cm. transverse skin incision is made 2½ cm. below the inguinal ligament over the fossa ovalis. The incision is carried down through the superficial fascia. The position of the femoral artery is ascertained by palpation. By blunt dissection, the greater saphenous vein is usually readily located in the medial portion of the wound deep in the superficial fascia and above the fascia lata. The vein is isolated from its bed and gentle traction applied while the vessel is dissected free upward and downward. (Fig. 2.)

As the vessel is dissected upward, several tributaries will be found entering the saphenous vein just before it passes through the oval window. All of these tributaries are severed between fine silk ligatures and divided. The saphenous vein is doubly ligated above its highest tributary or at the saphenofemoral junction with No. 2 silk. The vein distal to the ligature is then clamped and divided. The distal segment of vein is exposed and all tributaries within view are divided between fine silk ligatures. A provisional suture of No. 2 silk (*A*) is placed around the distal vein in the lower limits of the wound. The clamp on the distal vein is now released. A cannula is inserted in the open end of the vein and tied in position with a ligature. Depending on the size of the varices, 2 to 3 cc. of a 5 per cent solution of sodium morrhuate or "moru-quin" (5 per cent sodium morrhuate, 2 per cent alkaloid quinine and 2 per cent benzyl alcohol) are injected slowly. The provisional ligature previously applied below the end of the cannula is now tied. The vein is clamped above the ligature and is divided between the ligature and the clamp to prevent spillage of the sclerosing solution.

The wound should always be protected with moist gauze and flushed with saline solution before closing. Through and through silk sutures are used for closure with an occasional suture for skin approximation.

A supporting woven elastic bandage should be applied from the toes to the knees before the patient leaves the operating table, after which procedure the patient becomes ambulatory. The patient must wear the supporting bandage throughout the course of treatment and report weekly for additional injections needed in the leg or lower thigh.

Complications. Wound reaction may occur from spillage of sclerosing solution at the time of operation or leakage after

operation from the distal vein. Such reaction can be avoided by adequate wound protection and careful ligaturing. The author has avoided needle puncture of the distal vein for introduction of the sclerosing solution after the application of a permanent ligature for fear of leakage. With the use of the tied in cannula method, as previously described, leakage has not occurred.

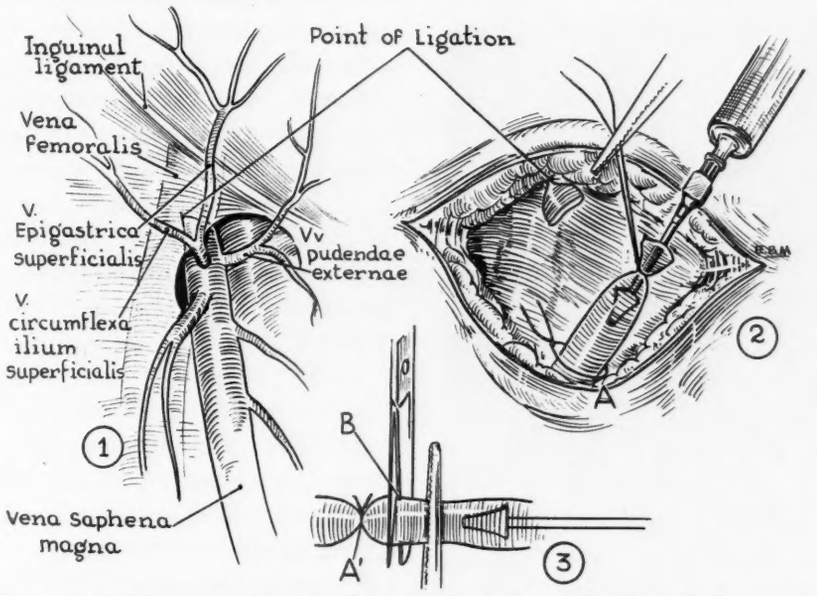

Fig. 2. (1) Schematic drawing showing the point of ligation of the great saphenous vein, proximal to its tributaries at the saphenofemoral junction. (2) The great saphenous vein dissected free with tied-in cannula in place. *A*, the provisional silk suture to be used for vein ligation after injection of the sclerosing solution. (3) *A'*, the ligature has now been permanently tied. *B*, division of vein between ligature and clamp.

Sloughs following ordinary injection of sclerosing solutions, are the result of faulty technic, usually, paravenous injection. Before any injection is made, aspiration should be made to prove the position of the needle. Following the injection, a pressure dressing should be applied directly over the site of vein puncture to prevent leakage into the tissues which would cause an unfortunate local reaction.

Embolism seldom occurs. McPheeters claims that the mortality rate from pulmonary embolism following injection treatment is seventy times less than that of the operative treatment of varicose veins. He believes that it is only when some complication such as acute infectious thrombophlebitis develops with injection treatment that there is a possibility of having an embolus after this treatment. Because of the direction of the venous flow in varicose veins, clearly demonstrated by lipiodal injections, emboli from segments of the thrombus breaking loose and spreading into the general circulation are very rare.

FAILURE OF INJECTION TREATMENT

Incompetent communicating veins at times cause early canalization in the superficial venous systems by creating unusual pressure at given points of communication. Correction of this condition may be accomplished by injection of the dilated segment of the superficial vein between tourniquets[3] placed above and below the entrance of the incompetent communicating vein. A firm thrombus will usually form preventing retrograde flow from the deep vein.

Inadequate injections due to failure of the patient to report for treatment may give poor results. A mutual understanding should exist between the patient and physician concerning follow-up treatment. The patient should understand that when vari-

cose veins appear, a more or less permanent circulatory defect exists, and that follow-up examinations are necessary to detect and

Fig. 3. Varicose ulcers, showing discoloration and pigmentation of the skin, eczema and induration of the tissues.

treat recanalization or newly formed varicosities.

VARICOSE ULCERS

Varicose ulcers are the result of incompetency of the venous circulation of the leg. The initial factors are usually varicose veins or deep vein thrombophlebitis. When these factors are present, nutrition is disturbed due to stasis of tissue fluids, rendering the leg vulnerable to infection. Ulcer may result from mild trauma or friction. The breaking of the skin surface and the susceptibility of the tissues to infection lead to a rapid necrosis with the formation of the characteristic varicose ulcer.

The *diagnosis* of *varicose ulcer* is usually obvious. They usually occur on the lower inner side of the leg associated with skin changes and varicosities. (Fig. 3.) The base of the ulcer is shallow with cyanotic granulations. Local pain and tenderness are common.

The *syphilitic ulcer* usually occurs in the upper part of the leg. The ulcer is punched out, usually deeper than the varicose ulcer and has a washed, leather appearance. The Wassermann test will be positive.

Tuberculous ulcers are rare on the leg.

Trophic ulcers usually result from long standing debilitating disease or local conditions bringing about constant pressure as from cast or brace. The skin first becomes dark red; rapid necrosis and ulceration to the bone often occur.

Malignant ulcers are infrequent on the lower extremities. However, when an ulcer does not respond to appropriate treatment, biopsy should be taken for histologic study.

The prognosis in varicose ulcer will depend on how efficiently one is able to stabilize the venous circulation of the leg. If competence of the saphenous system can be restored and maintained, permanent healing of varicose ulcer is to be expected. In cases of ulcer with advanced skin changes and indurative processes resulting from long standing chronic passive congestion, healing is retarded despite the most efficient management. When such an ulcer has healed, careful follow-up is essential to prevent recurrence.

Treatment. In recent years, the treatment of varicose ulcer has depended to a large extent on the application of mechanical pressure and for the most part has been ambulatory. This modern treatment is based on the principle that when the patient walks, muscular contraction aids in expelling blood from the leg veins toward the heart. Particularly is this true of the deep veins which seldom become incompetent. With incompetency of the superficial veins resulting in varicosities, the flow of blood is more or less influenced by gravity. When the patient stands, varicose veins will be filled with blood and the flow toward the heart is markedly diminished. When compression is applied to the leg, the reverse flow of blood in varicose veins is prevented, and with the patient ambulant, muscular action will aid in expelling blood from the deep circulation of the leg, thus maintaining more or less normal circulatory balance.

It has been shown that with the application of a supporting elastic bandage combined with rubber sponge pressure, the reverse flow of blood in the venous system into the ulcer can be overcome and thus the excessive accumulations of fluid in the tissues about the ulcer, which causes a lowered resistance locally, can be stopped. The resiliency of the rubber sponge with its massage effect, brought about by the muscular contraction of walking, has been likened unto a "rubber or venous heart." (McPheeters.) Thus with activity, the circulation in the area of ulceration is improved.

In all cases, a careful preliminary examination is made to rule out important complicating factors such as diabetes, nephritis and cardiac decompensation. These diseases should receive appropriate treatment while investigating the etiology of the ulcer.

The ulcer area is cleansed with tincture of green soap followed by alcohol, and is now ready for the application of the dressing. A dry dressing consisting of several layers of gauze is placed over the ulcer sufficiently thick to absorb wound secretion. A *rubber bath sponge* is selected which will overlap the edges of the ulcer. This is applied directly over the gauze dressing covering the ulcer. *The dressing over the ulcer should be inspected to make sure that the sponge pressure is placed directly over the ulcer.* Additional dressings are applied over the sponge and firmly bandaged in position by a 3 inch or 4 inch gauze bandage. A 4 inch elastic (Ace) bandage is applied to the leg from the toes to the knee. (Fig. 4.) It is important in bandaging the leg that equal and firm pressure be applied throughout. The patient is instructed to keep active and is encouraged to walk. Dressings should be changed as required, depending on the amount of drainage. This type of treatment should be continued until the ulcer is healed when the sponge may be discarded. The elastic compression bandage must be continued during and after the completion of treatment.

The injection treatment of the varicose

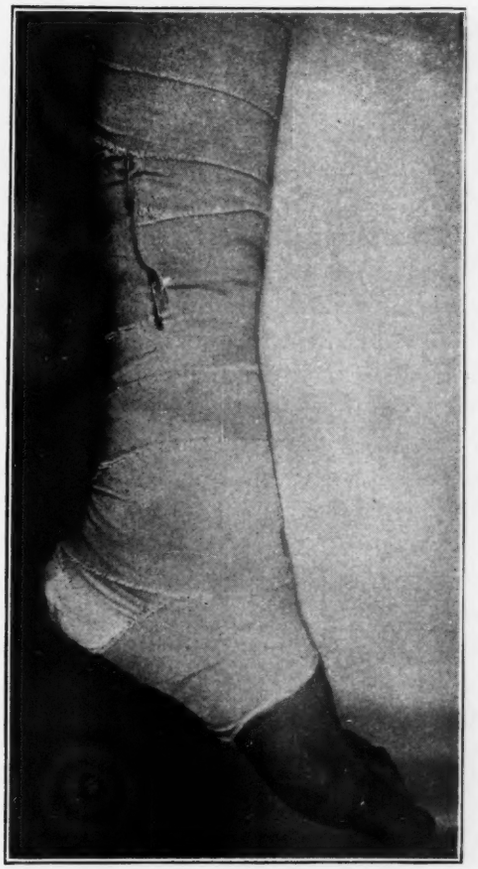

Fig. 4. Entire lower leg including rubber sponge now firmly bandaged with a 4 inch Ace bandage. Following this the patient is instructed to walk. (H. O. McPheeters and J. K. Anderson. *Injection Treatment of Varicose Veins and Hemorrhoids*, 2nd Ed. Philadelphia, F. A. Davis Company.)

veins may begin at any time. The writer prefers to wait until pain and local signs of inflammation in the ulcer area subside with compression treatment. High ligation, division and retrograde injection of the great saphenous vein is performed to be followed by subsequent local injections of sclerosing solution in remaining varicosities.

Comment. The use of ointments in the treatment of varicose ulcer as a routine, has been abandoned. Ointments have a tendency to retain wound secretion and in some cases seem to cause skin maceration and delayed healing. In the late phases of

ulcer repair, with sluggish granulations, a mildly stimulating and drying ointment is suggested. For this purpose, a 50 per cent ointment of bismuth subnitrate in petrolatum may be used.

Skin grafting in cases of varicose ulcer is seldom indicated or required. In the presence of healthy granulations and wide skin defect, remaining after the elastic compression method of treatment and associated varicosities have been obliterated, skin grafts may be used to hasten recovery. When skin grafts are used, it is essential that recumbent treatment replace ambulant treatment until the grafts are firmly fixed. Elastic compression bandage or Unna's paste boot should be worn continuously when the patient becomes ambulant.

The use of *Unna's paste boot* in the management of varicose veins and varicose ulcers as a means of obtaining gentle elastic pressure has proved to be very effective in the hands of those regularly accustomed to its use.[5] In the case of the punched out or deep ulcer, the rubber sponge may be used under the boot to apply elastic pressure to the floor of the defect.

As with varicose veins, the final result of treatment will depend on the careful follow-up management. The patient should be instructed to avoid trauma, and should be made familiar with the early use of bandage compression of the leg in the presence of signs suggesting recurrence of ulcer.

SUMMARY

The successful management of varicose veins and varicose ulcers requires a clear understanding of the anatomy of the venous system of the leg and the sequence of events associated with incompetency of the greater saphenous system and its tributaries.

The results of treatment will depend not only on the correct interpretation of tests for incompetency and the proper application of treatment, but the close cooperation of patient and physician during the entire course of treatment and for a long time thereafter, to prevent recurrence of varicosity and ulcer.

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WOUND CLOSURE, WITH PARTICULAR REFERENCE TO THE AVOIDANCE OF SCARS

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MEN have been repairing skin wounds for thousands of years. With the gradual advancement of surgery there has been an improvement in healing and wound closure. Today the average patient is likely to judge the surgeon, regardless of his diagnostic acumen, by the appearance of his incisions postoperatively.

The human body has not changed particularly in its healing powers, and in the length of time that has elapsed in surgical experience it would seem that there should be no problem of scarring following wound closure. Yet court calendars are filled with traffic personal injury cases demanding damages for scars following injuries. The majority of these patients have had attention by the first physician available or at the hands of receiving hospitals. The chances are that these were not the ideal wounds for repair.

Ideal Wound for Closure. The ideal wound is in a region allowing adequate pressure for immobilization following closure. The wound edges are of the same thickness and viability; the axis runs in the direction of the grain of the skin, so that the edges may be drawn together with a minimum of tension, or may be sufficiently undermined to assure easy closure.

Plan of Incision for Closure. This then should be the picture of the incisions of a planned operative procedure, but the resultant scars often transcend the deformity for which relief was planned. No one surgeon has yet achieved a scarless technic that holds good for all cases. However, we may attain increasing peace of mind by adherence to proved methods and in the presence of resultant scars attribute them to a slip in the technic or to the condition of the tissue.

Condition of Tissue. A healthy skin naturally presupposes perfect healing. Implant in it an acne, with some acute pustules, or cover a body having a lowered metabolic rate, and we are likely to see red, indurated scars which may go on to keloid formation. If the area of wound closure is in a hair-bearing region or near one of the orifices of the body where it is subject to contamination, our picture changes, although the skin may seem to be in perfect health.

New Wound Closure. The recent traumatic wound has a much better chance of healing kindly if the policy of conservative debridement (somewhat analogous to the clipping of flower stems to freshen them) is employed. Much damage, however, has been done by indiscriminate debridement which was advocated by Diffenbach 100 years ago, especially around joint areas and body orifices, a lesson we are relearning by experience since the necessities of the first World War surgery.

One surgeon will repair a recent wound with an excellent nonscarring result while another, under practically the same conditions, will have an utter failure cosmetically due to the rough handling of the tissues involved. "In every union there is a mystery—a certain invisible bond which must not be disturbed." (Amiel.) Preoperatively, the more meticulous the gentle soap and water scrub, followed by the removal of the soap by irrigation with normal saline, the less the necessity for the use of antiseptics. The fact that many wounds heal perfectly in spite of a careless preparation and closure should not encourage us to incur risks.

Closure Following Scar Removal. An area which has been allowed to heal by itself presents a problem of just how much

* Dr. Howard L. Updegraff died on August 8, 1940.

of the surrounding skin has been pulled over the healed area to satisfy the demands of the scar contraction. To the occasional dabbler in scar removal, the startling deficiency of tissue often following excision of the scar is a matter of sudden and grave concern as how best to repair.

If the old adage is true that no surgeon should open an abdomen without possessing the technical skill necessary to perform an intestinal anastomosis, then no surgeon should attempt the removal of an area of full thickness skin without the ability to employ the correct procedure to close the defect, even to graft skin if necessary, unless he is willing to explain a secondary closure or alibi bad scars.

While we are speaking of the avoidance of scars, let us designate the scars under discussion as those visualized by surgeons, rather than by patients, no two of whom have the same "mental" scar picture and whose experience is usually limited to members of their immediate family and varies from appendectomy incisions to vaccination marks.

Wound closure, in the presence of keloidal history, should be planned with the thought of early removal of sutures followed by adhesive support and treatment by radium with platinum filtration in divided doses. Preliminary radiation may be used, if employed either just before surgery or a sufficient period previously, so that surgery does not come during the reaction period. The term, "keloid" is another expression of which the average patient needs a definition and an accompanying explanation for its possible appearance.

Instruments. The planning and marking of incisions plotted so as to take advantage of the skin grain and tension lines should come under the head of "preoperative meditation." Five minutes spent in checking needles, sutures and general instrument setup, will save much time later, as the best of operating room nurses fail to put everything in at times. If we are to give special consideration to the avoidance of scars, it will be necessary for us to include in our "instrumentarium" a few items dedicated to such an aim.

First in importance are a half dozen small, single and double hooks of stainless steel with handles from four to eight inches long. With a little practice, they take the place of retractors or may be used in lieu of basting sutures, and if placed in the angles of the incision, greatly aid in correct closure. Their traumatizing quota is small and this influence should be continued in the choice of thumb forceps and mosquito clamps. Needle holders and small needles should be chosen for the site where they are to be used and for their sturdiness, in accordance with the toughness of the tissue undergoing repair. Thumb forceps with a minimum of crushing power and of slight resistance to one's holding grasp, keep the touch gentle. A good example is the Adson meningeal forceps. New Bard-Parker blades are dependable for clean cut edges. Full curved cutting needles such as Lane cleft palate or eye needles are excellent for skin suturing.

There should be a tendency to evert all incision edges rather than invert, unless one is deliberately trying to make a scar fit into the trough of a wrinkle. Undermining ordinarily should be as much again on either side as the width of the defect to be closed. Mild suction correctly placed at dependent drainage points is much kindlier to tissue than gauze mopping.

Sutures. Suture needs should be visualized before surgery. Catgut and silk size orders should specify the manufacturer, as no two have the same standard of sizes. The use of silkworm gut and horsehair for skin closure is fast loosing favor. Dermal with buttons for deep tension support is acceptable, provided the buttons are pillowed with vaseline gauze.

The correct size suture is the smallest one allowing approximation without breaking. The ideal suture then should allow easy apposition and yet adequate splinting against underlying muscle action. The breaking of sutures is usually an indictment of the surgeon rather than of defective

suture material. "Tying with the elbows," is still considered bad form in the surgical "Emily Post."

It is our practice to use triple o plain catgut for ties and subcutaneous approximation and double o plain catgut for important tension points. Chromic catgut is used only where deeply buried. Silk has come to be the suture of choice for skin approximation, and covered by several layers of vaseline parrasine gauze, may be left in place from two to five days until it becomes too tight or too loose. The use of buried silk will continue to gain favor, as long as it is buried deep and is fine enough. Mason states that "the heaviest silk should not be larger than the smallest catgut."

Wound Support. Skin support following closure is of immense value, regardless of the length of the incision line, as the smallest scar in a prominent place may be a source of great embarrassment to the patient and incidently the surgeon. The removal of the sutures is a double incentive to support, best obtained by crosswise adhesive strips, in which diamond-shaped perforations have been made to insure escape of possible drainage. These strips should be applied with the thought of not only holding the wounds edges together, but also of combating possible extra tension from increased movement as convalescence progresses.

Facial scars are more acceptable, if dressed with "flesh color" adhesive. The patient will wear it much longer and the incision line will benefit accordingly. As a matter of psychology I have noticed that patients with mastopexies and lipectomies, (commonly covered areas), object less to flesh colored adhesive over longer periods of time, than those subjected to ordinary adhesive, especially the "water proof" types which are too hard and stiff for ordinary wound support.

The main objection to the use of adhesive in the supporting of wound edges seems to be in the pain occasioned by its removal. Numerous agents for removal have been placed on the market. Ordinary benzine carefully introduced by cotton applicators between the skin and the adhesive is a satisfactory method, if care and skill are combined with its use. Many a new patient comes to the surgeon recommended by his reputation for gentleness in removing dressings, rather than for his skill in the operating room.

On certain types of oily skin and on babies' faces, where adhesive is sometimes especially irritating if removed often, one may lengthen the period between removals if they will first cleanse the skin with benzine and alcohol, and then paint with compound tincture of benzoin to form a protective and improved base for the adhesive. This is also advantageous during cold weather when even the flaming of adhesive is not always sufficient to make it stick.

Support of Abdominal Incisions. Following hospitalization the average patient is often sent home with an ill-fitting abdominal support, which usually irritates the recipient enough to make him forget the surgeon's kindness in the hospital. The wound edges soon register permanent protest in the shape of angry scars for months to come.

The support of abdominal incisions by "adhesive corsets" made up of three inch strips of adhesive, with hooks for tape lacing, aids materially in changing dressings. Following the removal of sutures additional support should be applied for at least thirty days by crosswise one inch wide adhesive strips with perforated openings over the incision line. The combined adhesive strips should be wide enough and long enough to act as a girdle and they need not be changed every time the patient appears. The portion over the incision line may be renewed when soiled and superimposed adhesive placed over the old which is left on to protect the outlying skin.

The support of abdominal scars with adhesive tape should be figured in weeks rather than days, if one is to combat widened scars successfully (and bridge table conversation of results). Following removal of the adhesive support cross

strips, a single piece of adhesive slightly wider than the actual scar surface and the length of the incision should be applied. This may be done by the patient after a suitable time and gives him a feeling of continued partial immobilization and support.

Immobilization and Pressure. Immobilization of wound edges is of course the aim of wound closure. Various additional procedures may be utilized, as for instance, the "Bowman splint" used for postoperative harelip dressings, may be used for support of any other exposed suture line. The late John Wheeler, one of our greatest eye surgeons, was a staunch advocate of sewing the eyelids together in many types of surgical repair of the eyelids. The use of plaster of Paris for support, now being replaced by a lighter cast material, is an aid to immobilization that has achieved merited popularity. The combination of such as these, with the use of intelligently applied pressure on the sutured and undermined surfaces, further aid scar avoidance.

Pressure is employed as a splinting measure in clean recent wounds and as a preventive of hemorrhage, edema and localized postoperative movement. It should encompass the undermined area and be of sufficient force to control arterial and venous circulation of the skin yet allow the flow of lymph. This amount of pressure has been determined as around 15 mm. of mercury. Favorite methods vary from fluffed gauze under stockinet bandage reinforced by adhesive to a marine sea sponge cut to size and similarly held. Sufficient compression should be applied preliminary to bandaging to express any blood clot which might have formed previous to the beginning of this period of immobilization.

It is most important that restraint and major splinting protect the initial dressing. The possible employment of ice bags, sand bags, pillows, with the prescribing of the correct position and administration of sufficient sedatives or narcotics along with possible shock measure, must be kept in mind. "Primary union with a minimum of disturbance" then is the watchword made possible through immobilization. The word, "immobilization," means different things to different patients. The average patient interprets it as meaning to stay in the house and possibly bed yet he will chew gum, brush teeth, smoke and have lengthy phone conversations in the presence of a complicated facial scar repair unless specifically warned not to.

General Surgical Conditions Influencing Closure. The type of dressing is influenced somewhat by the choice of anesthesia and should be planned, not only for pressure and possibility of early inspection of the wound, but also for its removability postoperatively. Wounds in the hair line should be shaved and the use of collodion and adhesive on unshaven areas should be given thought before applying. This is especially true in elective surgery. The use of caps, mask over nose and gloves are of the same importance as in abdominal surgery, especially in rib cartilage grafts. Yet we all have seen completely regimentated operating rooms, visited by the Chief of Staff in a business suit sans mask or gown, or the head nurse of the operating room floor cruising from one surgical unit to another, evidently protected from delivering infection by her title.

Anesthesia. One of the most important features of hospitalization for emergency wound closure is that it include the services of an experienced anesthetist. He should be given sufficient time if possible to size up the patient, so as to chart his course depending on the general condition, necessity of shock treatment, need of preoperative medication and some inkling of the time involved for the repair.

I like endotracheal anesthesia as an adjuvant for the majority of wound closures coming under the grist of facial plastic surgery. While the introductory measures are time consuming, they save in repair time and offer a far greater return by divorcing the anesthesia problem from the surgical area. For elective surgery with its extended periods of time, it is the method par excellence. Anesthesia makes little

difference in scar formation following wound closure, except as an aid to the surgeon to allow him to do a better repair. Different types of patients, surroundings and physical conditions all demand their equivalents in the choice of an anesthesia. The main point is that the surgeon who will be held responsible in the end for scars should assert himself at the time of surgery for the use of those aids which will help him the most.

COMMENT

The most successful wound closures with a minimum of scarring are obtained only in the security of the operating room. Here are multiple advantages, such as repairing the wound at the best time for the patient, elimination of the haste engendered by the necessity of shock treatment and the promise of after care allowing for the administration of anesthesia and preoperative and postoperative sedatives. Added to this is the possibility of adequate and thorough cleansing of the wound with the option of immediate or delayed repair. The so-called six hour time limit for infection may be reasonably extended under the favorable circumstances of hospitalization and the possibility of hospital after care. The disadvantages which exist in the combination of an onlooking family and friends, in an office not designed exclusively for surgery, versus the advantages and serenity of a masked and gloved operating room staff, cannot be compared when the final score is posted for the presence or absence of good results, namely, scars.

THE CORRECTION OF SCARS*

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SCARS usually follow the destruction of tissue resulting from trauma, burns, operation or disease. Their appearance or their painfulness may annoy the patient or they may cause limitation of function. If an operative correction of such scars is undertaken, several general rules must be observed. The tissue which formed the scar must have reached a state of quiescence, recognizable by the pale color and softness of the scar. With a simple scar this stage may be reached by the end of the fourth week. Scars due to burns, however, may not be operable before the end of a year. Massage and *x*-ray treatment often help to shorten this time.

In discussing the plastic repair of scars it is important to distinguish between simple and extensive scars. Both types can be smooth, hypertrophic, depressed or contracted.

The Correction of Simple Scars. The *simple scar*, whether smooth or hypertrophic, is not always easy to correct. The incision outlines the scar and penetrates at either side of the scar into the subcutaneous tissue, but not deeper. The subcutaneous tissue is kept intact to act as a basis upon which the wound edges should be approximated. (Fig. 1A.) With a pair of fine, sharp, curved scissors the scar is excised. The wound edges are mobilized and separated from the subcutaneous tissue in a circumference of about 1 cm. Exact hemostasis is the next step. If possible, ligatures should be avoided and the bleeding controlled by pressure. If ligatures are unavoidable they should be made with the finest silk. The suture of the wound edges should be carried out with horsehair and consist of on-end mattress sutures supplemented with simple interrupted sutures.

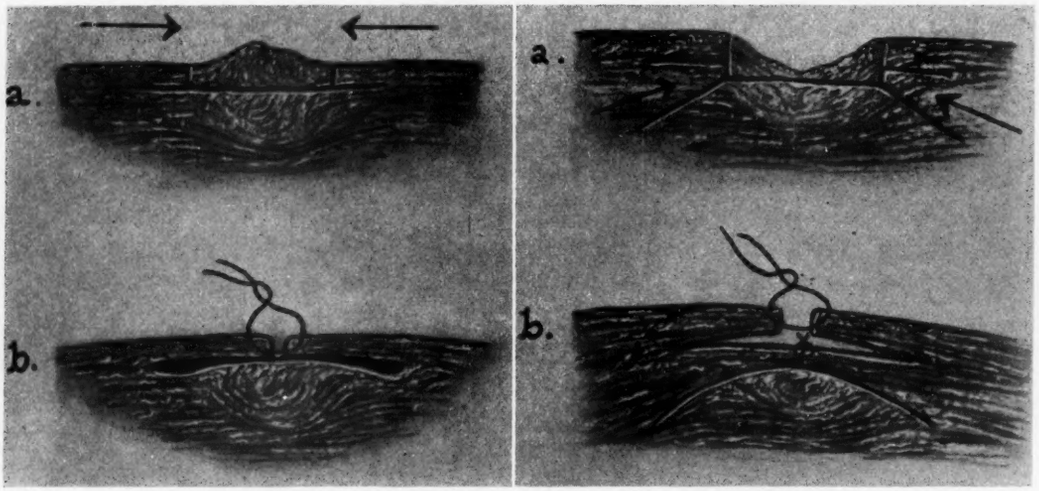


FIG. 1. *a*, correction of simple hypertrophic scar; excision of scar, leaving basis of scar intact upon which the wound edges are approximated. *b*, correction of simple depressed scar; excision of scar leaving basis of retracted area intact. From the corners of the defect a bilateral incision is carried obliquely downward and outward. The mobilized skin and subcutaneous tissue is approximated upon the scar buttress.

* From the Surgical Services of Lankenau, Germantown and Chestnut Hill Hospitals. Presented before the Philadelphia Academy of Surgery, November 6, 1939.

The wound edges are not grasped with a forceps but only elevated by one prong to facilitate the penetration of the needle.

If the simple scar is *contracted*, the entire scar tissue, including the base, must be excised until the whole defect thus created

A B

FIG. 2. A, correction of depressed scar in right nasolabial fold and of contracted scar of lateral part of right eyelid. B, scar in nasolabial fold corrected according to technic as represented in Figure 1*b*; scar of right eyelid corrected with Z method.

If the wound edges are not under tension and are straight, Halsted's subcuticular wire suture is of value. I prefer to cover the wound with silver foil which keeps it dry and aseptic. The simple sutures are removed on the second or third day; the remaining sutures on the fifth day after operation.

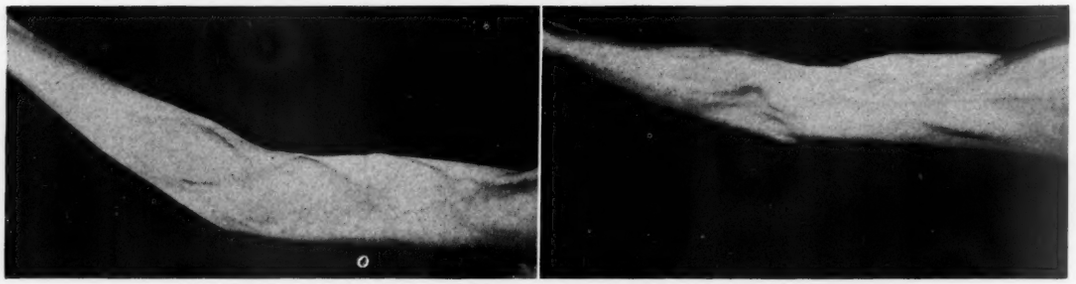
If the simple scar is *depressed*, the technique for correction differs. The incision outlines the scar and penetrates at either side to the base of the retracted area, but not further. The scar is now excised as previously described. From the deep corners of the defect a bilateral incision is carried obliquely downward and outward, leaving the base of the scar intact to act as a buttress. (Fig. 1B.) The adjoining tissue thus mobilized is approximated upon this buttress and transfixed by on-end mattress sutures supplemented with simple interrupted sutures. (Fig. 2.) In some instances it is better to suture subcutaneous tissue and skin in layers after mobilization of the skin edges from the subcutaneous tissue.

consists of normal tissue. One ordinarily succeeds now in releasing the contracture unless the latter has been of long standing. Usually some sort of tissue shifting is necessary to close the defect. In cases where the contracture is due to a binding web the Z type of relaxation incision with exchanging flaps is the operation of choice (Davis[1,2]). The object of this operation is to interrupt and displace the binding web by the formation and transposition of two triangular flaps which are placed so that their outlines form a Z. The central line of the Z is laid along the most prominent portion of the web and the arms of the Z are marked out on opposite sides of the central line. The two triangular flaps thus outlined are mobilized. The contracture is now reduced as far as possible and the two flaps are transposed. If the binding web is long, several such Z's may be formed and their flaps transposed as demonstrated in Figure 3.

Correction of Extensive Scars. Extensive smooth scars are in the same plane as the skin. Ordinarily they do not cause any

trouble since they do not contract. However, they tend to become annoying if they are situated in such exposed regions as the face or neck. In these cases repair work may be requested. If the scar is not too extensive and elliptical and the surrounding skin is freely movable, the scar is treated as if it were simple and smooth. It is excised down to the subcutaneous tissue, but not further. The wound edges are mobilized subcutaneously and approximated until a linear suture can be established. If the defect left after excision of the scar is triangular (Fig. 4) or rectangular (Fig. 5) and the surrounding skin is freely movable, plastic closure might be achieved by starting with closure of the corners.[3] It is important to avoid undue tension in the sutures by choosing a procedure by which the scar is partially excised and sutured in several stages. During the intervals the skin is allowed to stretch until all parts of the scar are removed. If the scar is too large to permit closure of the defect by simple tissue mobilization or tissue gliding, covering of the defect by a full thickness skin graft or pedicle flap is advisable. The disadvantage

A



B C

FIG. 3. A, correction of simple contracted scar by the Z type of operation. The central lines of the two Z's are laid along the web. The arms of the Z's are marked out on opposite sides of the central lines. The two triangular flaps of each Z are transposed. B, same patient six months after operation. C, same patient one year after operation.

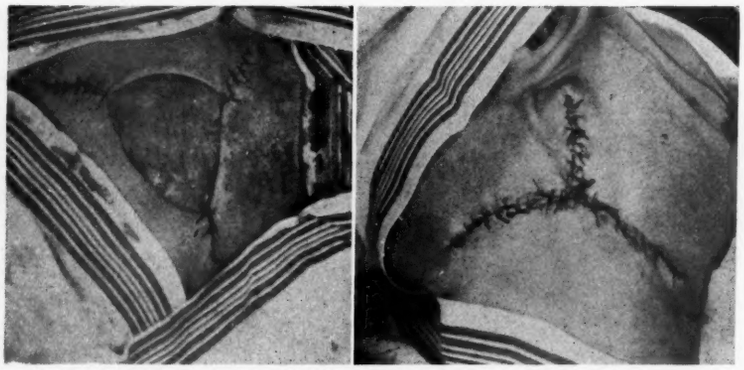
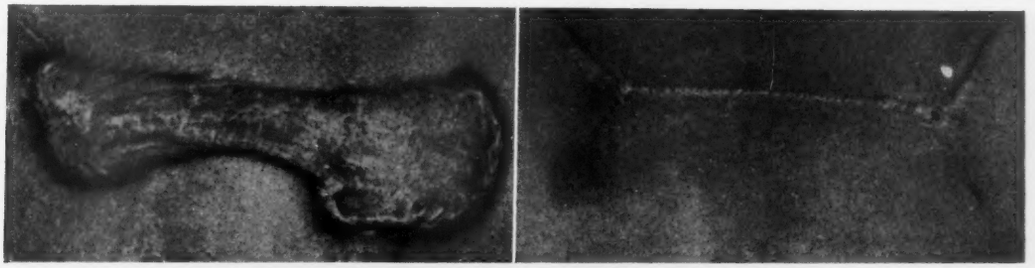


FIG. 4. Triangular defect after excision of flat scar closed by starting with closure of the corners.

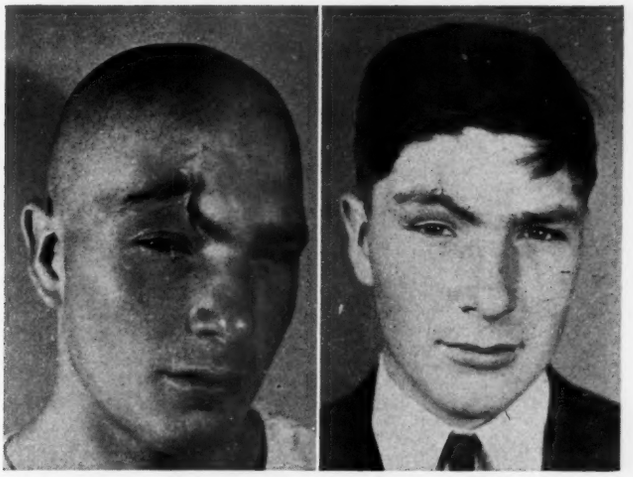
of the graft or flap, however, is the difference of color and a slower healing process.[4]

The *extensive hypertrophic scar* is usually due to keloid formation. We do not know as yet the cause of keloid development and for this reason the treatment is rather vague. It is a well known fact that even after a complete excision of a keloid it may recur after a few weeks no matter whether the defect is sutured primarily, covered by a skin graft, left to granulate, or electrocoagulated. The most efficient treatment at the present time is radiation by *x*-ray or radium, preferably after excision of the scar. If the keloid extends over a large area and this area happens to be in a place where the skin is very movable, one may attempt an excision of the entire area. The skin surrounding the defect is mobilized and approximated until a linear suture can be established. *X*-ray treatment is applied postoperatively. If this scar, in spite of excision and radiation, develops again into a keloid, the second is many times smaller than the first. (Fig. 5.)



A B

Fig. 5. A, rectangular defect after excision of large keloid scar closed by starting with closure of the corners. B, same patient ten months after operation.



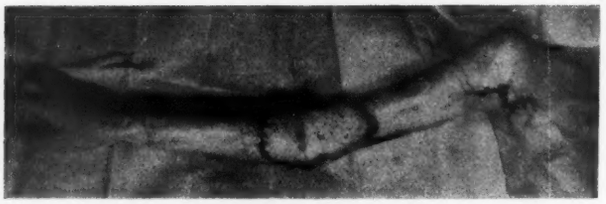
A B

Fig. 6. A, large depressed scar of forehead with displacement of right eyebrow. B, same patient seven months after excision of scar, rotation of right side of scalp and transplantation of fat tissue.

If an extensive scar is retracted or depressed, the technique of correction differs from that used in simple depressed scars. In the majority of cases the involved area is too large to allow an approximation of the neighboring subcutaneous tissue to fill the defect. Hence the repair work is mostly combined with grafting fat, bone or cartilage in order to restore the normal surface contours. The scar is excised down to its base. The skin surrounding the defect is mobilized; then, after careful hemostasis, a properly shaped piece of bone, cartilage or fat is transplanted into the defect before the skin is closed over it. The choice of the

material is not free but is dictated by local conditions. If grafts of fat tissue are used their subsequent shrinkage must be taken into consideration. The shrinkage amounts to about two-thirds of the size of the graft. Cartilage and bone are not apt to shrink. I prefer to take fat tissue grafts from the outer posterior surface of the thigh, cartilaginous tissue from the fused portions of the seventh and eighth ribs, and bone from the anterior surface of the tibia. If simple mobilization of the skin does not suffice to close the defect over the graft, additional incisions must be made to allow more liberal shifting or rotation of skin. In such cases, however, secondary defects may be left and one must be sure that they can be closed. In extreme cases transplantation of skin by pedicled flaps is the last resort. A patient was kicked by a mule on the right side of the forehead when he was 4 years old and acquired a deep depressed scar due to bone and skin defect. His right eyebrow was split and the lateral half displaced upward. (Fig. 6.) When he was 21, I excised the entire scar, mobilized the surrounding skin and filled the depressed part with fat tissue taken from his left thigh. To rotate the displaced lateral half of the right eyebrow the incision was lengthened upward and backward, thus outlining a large flap consisting of nearly the entire right half of his scalp. The flap was mobilized and was then easily shifted downward, covering the original defect and allowing alignment of the right

A



B

FIG. 7. A, eight year old boy with contracted scar of right elbow joint and axilla due to burns. The burned area included the entire right half of chest and abdomen. A tubed flap was formed from left thoracico epigastric region (Webster). B, the tubed flap was transplanted into the defect of the right elbow after contraction had been overcome. Contraction of right axilla was corrected by the Z operation.

eyebrow. The secondary defect at the occiput could then be closed.

Correction of *extensive contracted scars* is one of the most difficult problems in plastic surgery. The extensive contracted scar is usually caused by destruction of the deeper parts of the surface tissue, and appears usually at the flexor surface of the extremities or at the junction of limb and trunk. In some cases much can be done to avoid them to a greater or less degree by proper immobilization of the affected limb during the healing stage. Before any operative correction is undertaken, one should wait until the scar tissue has reached its final stage, although waiting to long may cause joint ankylosis and shortening of tendons and ligaments. Active and passive motion exercises of the affected limb during the waiting time is advisable. The objects of treatment are to remove the scar, to replace it by normal tissue, and to restore function. The scar must be removed entirely until normal tissue is exposed; only then can contracture be overcome. The defect is covered by a skin graft or pedicled flap, the proper choice of which is dictated by the local conditions and the peculiarities of the various kinds of transplants. (Fig. 7.)

If a scar is very large, however, as after extensive burns involving the entire thigh or leg, it is inadvisable to remove the whole scar as it would be impossible to obtain sufficient skin with which to cover the defect. To relieve these large, thick, contracted, adherent scars, Davis[1] advises relaxation incisions. The contracted portion is stretched and the most binding area or areas are located and marked out. The scar is divided completely until normal tissue is reached. Sometimes radiating incisions from the tight margins are necessary to complete relaxation. If, after the relaxation incisions are made, the scar is found to be very thick, Davis advises excision of a wedge-shaped slice of the deeper layer so that the thinned surface edges may be drawn downward and attached to the normal base by a few sutures. The defect is covered primarily or secondarily with skin grafts.

If the cicatricial area is too extensive the procedure should be done in stages. In the case represented in Figure 8 the binding web was so long that two relaxa-

A B

Fig. 8. A, large contracted scar of right leg. B, same patient eight months after division of binding web of scar, correction of contraction and skingrafting of defects.

tion incisions were necessary. The edges of the defect created after the incisions were unusually thick—1½ inches. Although slices of the deeper tissue were excised and the surface edges attached to the normal base, yet the defect remained quite deep. The defects were covered with split grafts which, however, partly sloughed away, particularly at the edges. The leg was immobilized in a plaster case for four weeks. After this time granulations had filled out the entire defect, had raised the surviving parts of the grafts from which epithelization spread over the granulating surface with resulting healing. (Fig. 8.) The same relaxation incisions are recommended by Davis for so-called unstable scars where healing is very poor.

SUMMARY

The plastic repair of scars is discussed under two headings: correction of simple scars and correction of extensive scars. Both types can be smooth, hypertrophic, depressed or contracted. Suitable methods of repair are described for each type of scar.

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CORNS—THEIR ETIOLOGY AND TREATMENT

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GALLAND[1,2] and Lapidus[3] have shown that the effective treatment of a persistent painful corn depends upon an appreciation of the basic cause underlying the development of the corn.

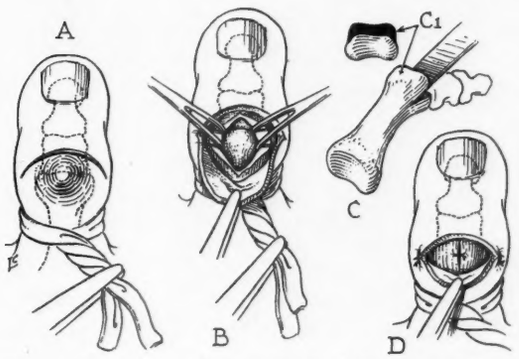

FIG. 1. Illustrates the method of dealing with the dorsal corn.

ETIOLOGY

A corn is produced by a shoe which causes friction and pressure on the skin of a toe at a point where a bony prominence underlies the skin. Roentgenograms may show a definite exostosis, but more commonly the bony prominence underlying the corn is seen to be a prominent portion of some normal bone structure. The etiology, then, is similar to that of bunion.

Toes presenting corns are either cocked-up, flexed at the phalangeal joints or exhibit a varus or a valgus deformity. All of these abnormalities, slight as they are in many cases, accentuate the normal points of bony prominence which function as pressure points between the toes themselves or between the toes and the close-fitting shoe. About these prominent portions of bone soft tissue reactions occur which lead to fibrotic changes and corns develop. Many corns have accompanying bursae between them and the underlying bone.

Toes with normal relationships between their component parts and with other toes do not develop corns. Shoe pressure is applied evenly over the entire surface of these toes. No one point takes the brunt of the shoe pressure.

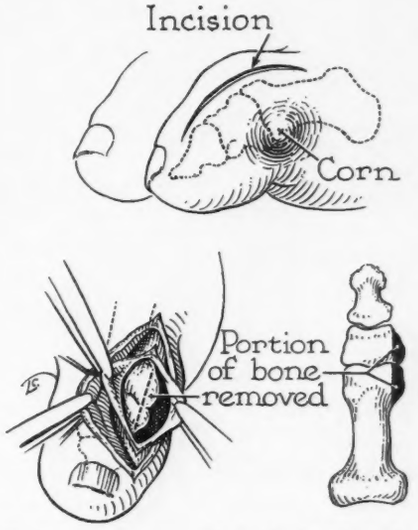

FIG. 2. Illustrates the surgical approach and the portion of bone removed in dealing with the common fifth toe corn.

CLASSIFICATION OF CORNS

Hard Corn. This corn is characterized by a horny induration and thickening of the skin on an exposed part of the toe. It may vary in appearance from the large clavus with a definite conic center to the extremely vascular corn which the slightest trimming will cause to bleed profusely. The common sites for this corn are over the dorsum of the second to the fourth toes and over the dorsolateral surface of the fifth toe. The usual location is over the dorsum of the proximal phalangeal joint, but this corn is found at times over the distal joint as well.

Soft Corn. This corn appears between the toes and exhibits more or less macera-

tion due to moisture. Two varieties are noted:

A. The Phalangeal Joint Corn. This is present over a bony prominence on the lateral or medial side of one toe and has its counterpart on the medial or lateral side of the adjacent toe. The common sites for this corn are between the most lateral three toes in the region of the proximal phalangeal joint. (Fig. 4.)

Fig. 3. Roentgenogram showing exostectomy site for fifth toe corn. Compare with Figure 2.

B. The Phalangeal Base Corn. This corn is not uncommon. It may be extremely painful. It is situated deep in the web between two toes. It is caused by a prominent phalangeal base of the proximal phalanx of one of the toes. The base of the phalanx is made prominent by a fixed dorsal extension of the toe at the metatarsophalangeal joint. This produces an abnormal relation of the base of the phalanx to the toe next to it, and pressure results. The most common site for this corn is between the fourth and fifth toes. When present in this location, it is caused by a prominent lateral portion of the base of the proximal phalanx of the fourth toe. (Figs. 5, 6, 7, 8 and 9.)

TREATMENT

Shoes and Stockings. Palpation of a corn with the toe in its unrestricted position will reveal the underlying bony prominence if the deformity is fixed. If the deformity of the toe is not fixed, the prominence may not be present except when the foot is enclosed in a stocking which is too short or in a shoe which does not fit the foot well. In either case, the toe will be thrown into an abnormal position, and a corn will develop at the point where the greatest contact pressure is applied. The simplest and the most effective treatment for many corns is correctly fitted shoes and stockings.

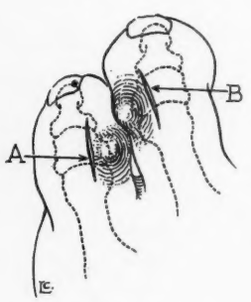

Fig. 4.

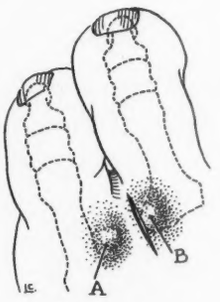

Fig. 5.

Fig. 4. Illustrating the phalangeal joint corn and the incisions used.

Fig. 5. Illustrating the phalangeal base corn and the incision used to split the web and expose the prominent phalangeal base.

Sole Wedges. A painful corn on the dorsolateral side of the fifth toe is relieved at times by a small outer sole wedge.

Adhesive Plaster and Mole Skin Pads. These pads when applied directly over the corn relieve friction and prove adequate in many instances.

Felt Pads. Commercial pads are usually in the form of a ring which surrounds the corn. Many corns are better treated by a simple felt block placed proximal to the corn. One way to apply the block is to cut a piece of good grade felt in the shape of a signet ring. This block is easily adjusted to slip over the toe with the block just behind the corn. This block is applicable to both the hard and phalangeal joint corn. The phalangeal base corn is at times relieved by a small metatarsal pad placed just behind the metatarsal head of the offending toe. This pad may correct the extension deformity and thus relieve the pressure.

Paring and Skiving. This treatment is best carried out by a skilled chiropodist.

When this form of treatment is performed on correctly selected patients, it offers temporary relief. Patients with diabetes or who have evidence of inadequate circulation in the feet should not be chosen for this form of therapy.

Fig. 6. Arrow indicates prominent phalangeal base. Same case as Figure 7.

Fig. 7. Arrow indicates operative site. Correct amount of bone removed. Note that exostectomy of first and fifth metatarsal heads has also been done.

Operative Treatment. The only way for a patient to obtain permanent relief from a painful corn in the face of persistent wearing of tight shoes, is by having the underlying bony prominence removed. If the bony point is adequately removed, the patient is relieved of both the pain and the corn.

Persons seeking relief from pain sufficient for them to accept operation should be free of diabetes and should have adequate circulation of the foot and toes. Further, the fixed deformities of the toes must be mild. For severe toe deformity other procedures than simple exostectomy are indicated.

Fig. 8. Illustrates prominent phalangeal base fourth toe, bilateral.

OPERATIVE TECHNIC

Preparation of Field. (1) The foot is prepared the night before by shaving the toes and then cleansing the foot with soap, alcohol and ether. A sterile dressing is applied. At operation an ether-iodine ritual is observed. (2) The toe to be operated upon is exposed and the distal portion of the toe is covered by a rubber cot. (3) The base of the toe is injected with 1 per cent novocaine. (4) When feasible, a rubber band is placed about the base of the toe and its ends are caught by a hemostat. The hemostat is twisted until a tourniquet effect is obtained. If this method is followed, it is virtually impossible to leave on the tourniquet inadvertently.

FIG. 9. Same Case as Figure 8, three years after operation. Exostectomy too generous, but no dislocation has occurred. Note protective pad worn for corn on fifth toe, left, which appeared after surgery. This corn is due to slight varus deformity of the fifth toe, which developed due to the medial subluxation of the fourth toe at the metatarsophalangeal joint. This subluxation results from too generous removal of the phalangeal base.

Hard Corn. The bony prominence commonly is formed by the dorsal portions of the condyles of the phalanx proximal to the joint. At times the dorsal portion of the base of the phalanx distal to the joint is also a factor.

The incision for the dorsal corn is a small U-shaped incision which develops a flap with a wide base proximally. This incision is carried through the skin. The expansion of the extensor tendons and the digital arteries should not be cut. The skin flap is turned back. The dorsal expansion of the tendons and the joint capsule are split longitudinally and in the midline. These structures are raised by means of a periosteal elevator or a small chisel and are retracted to their respective sides. This will expose the condyles and the adjacent joint cartilage. Gentle handling of the skin flap is observed throughout the operation.

The bony prominence which is the complete dorsal surface of the condyles is removed with a small chisel. The exostectomy site should be trimmed until the surface has rounded sides and a flat top. With the toe in its accustomed degree of flexion, the adjacent portion of the base of the phalanx should be flush with this new surface. If this is not the case, the exostectomy site or the base of the phalanx is trimmed until this condition exists.

The capsule and then the expansion of the extensor tendons are brought together and sutured. The skin flap is sutured in

place. The tourniquet is removed, and the toe is bandaged in as much extension as possible. (Fig. 1.)

The prominence on the fifth toe is reached through the incision as shown in Figure 2. The prominence here is often formed by the dorsolateral surface of both the condyle and the base of the adjacent phalanx. In any case, the surface of the exostectomy site should be adequate, smooth and rounded so as to blend gradually with contiguous bone surfaces. Careful palpation through the skin before the wound is closed will reveal any overlooked prominence. If one is found, it should be removed. The base of the phalanx and the adjacent portion of the condyle must be made flush with each other. (Figs. 2 and 3.)

Soft Corn. The prominence of the *phalangeal joint corn* is usually on one toe only, but a prominence may be on each of the involved toes. Palpation of the corns will reveal this fact. The incisions used are shown in Figure 4. The exostectomy must satisfy the same requirements as stated above.

The prominence of the *phalangeal base corn* is reached through a web-splitting incision which is made slightly towards the side of the prominent phalangeal base. (Fig. 5.) These wounds bleed profusely at times, but the exposure must be adequate so the exact amount of bone to be removed can be visualized. One-third of the expansion of the phalangeal base may be removed. (Figs. 6 and 7.) If more than this is removed, subluxation or dislocation of the toe may result. (Figs. 8, 9 and 10.) The wound is closed and the toe is bandaged in slight plantar flexion at the metatarsophalangeal joint.

After Care. (1) Allow walking to begin between the third and the fifth day. (2) Remove the sutures on the tenth to the fourteenth day.

Remarks. Curretting the corn is not necessary. The corn disappears in from three to four weeks after operation. It does not recur. The scar becomes almost invisible.

Cutting out the corn by an elliptical incision may make the closure of the wound difficult.

Fig. 10. Illustrates dislocation which will result if too much of the lateral expansion of the phalangeal base is removed at time of operation.

Amputation of a toe for an uncomplicated corn is not necessary. Other conditions may exist in the toe which call for amputation but not the corn itself.

SUMMARY

A corn is produced by a shoe which causes friction and pressure on the skin of a toe at a point where a bony prominence underlies the skin. This pressure may be direct or it may be transferred to bony prominences between the toes. Palpation of the corn will reveal the prominence.

Conservative methods of treatment are presented. If these fail, operative cure of the clavus is described.

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A NEW TYPE OF DRESSING FOR BOILS AND CARBUNCLES

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A RELATIVELY noncontaminating and painless type of dressing for boils and medium-sized carbuncles, especially of the neck, buttocks and trunk, has been devised.

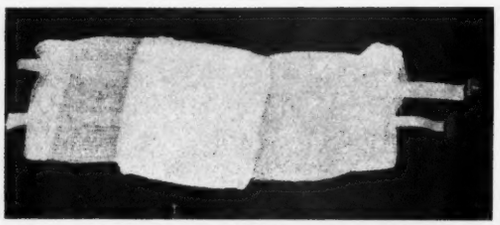

FIG. 1. Inner view of the prepared dressing.

The dressings are easy to make (Fig. 1) and to change. They are constructed by putting from two to four 3 by 3 inch gauze pads on the center of a 3 by 9 inch gauze pad. The bundle of smaller gauze pads is held in place on the 3 by 9 inch gauze pad by means of four adhesive tabs, three-fourths to 1 inch in length and one-third inch wide. The 3 by 9 inch dressing, which is the retaining dressing, is held in place by means of two pieces of adhesive, one-third inch wide and ten and one-half inches long. The ends of the adhesive that hold the dressing to the skin are thus only three-fourths of an inch each, in length. The ten and one-half inch strips are placed with their outer edges about three-fourths of an inch from the outer edges of the retaining dressing.

FIG. 2. Typical infection of the neck, which had been treated previously by an old type dressing. The upper incision is over the original carbuncle. Note the lower incision over the secondary boil, which had formed as a result of contamination of an opened hair follicle.

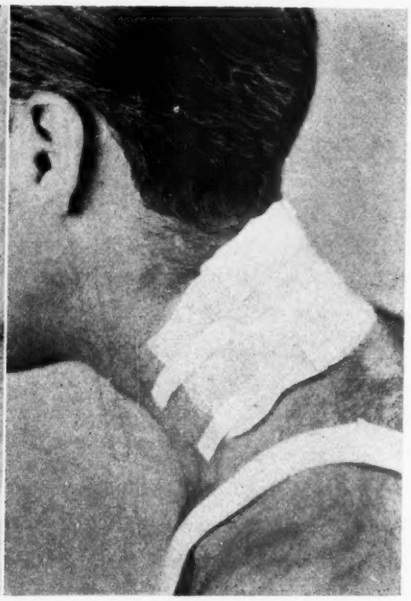

FIG. 3. A three quarter view of the applied dressing. Note the distance from the site of infection to the point of attachment of the adhesive tape.

The skin over the area where the adhesive is going to be fixed is shaved with an

electric razor and cleansed thoroughly with benzene and alcohol before the application of the first dressing. The dressing is then applied over the center of the infection. (Fig. 2.) The inferior strip of adhesive (Fig. 3) is pulled rather tightly.

Each time the dressing is changed (once or twice daily), the area is cleansed with a solution of 1 dr. of salicylic acid to 4 ounces of spirits of vini recti. Any small secondary pimples are painted with one half strength tincture of iodine. Any hypertonic, aqueous based ointment may be used on the boil or carbuncle.

There is less danger of contamination of the surrounding skin, for the following reasons: The hair follicles, which are opened by the removal of the adhesive, are situated some distance from the site of infection and therefore do not tend to become infected. The pus is confined to a more limited area by the use of the bundle of gauze squares than if a larger dressing were used. Contamination of the skin, due to gravity drainage of the pus, is diminished by having the inferior strip of adhesive drawn quite tightly.

There is a hypersensitivity of the tissues about the infected area, and movements of the head cause a very painful tension on the skin and hair with the ordinary dressing. This new type of dressing is much more comfortable. The attachment of the tape to the skin is some distance from the inflammatory zone and is on an area from which the hair has been removed with an electric razor. For the same reasons, removal of the tape is relatively painless.

ELECTROSURGERY

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THE practical application of surgical diathermy is a matter of correct technic. Fortunately, this technic is not complicated. The considerations which form the basis for the application of medical diathermy hold equally true for surgical diathermy. The essential difference is the fact that in surgical diathermy sufficient heat is developed to cause an actual destruction of tissue. The method may be varied in essentially four different ways. These are called fulguration, desiccation, coagulation and the application of the electric cutting current.

FULGURATION

In *fulguration* the current is permitted to arc from the point of the needle to the surface which is to be destroyed. The action of this procedure is superficial. Only a very thin layer is destroyed. In order to cause the current to create a spark between the tip of the needle and the treated surface of the body, two different technics may be used. In the one, the needle held in a holder is connected directly to the Oudin terminal of the machine. In the other, a metal plate is attached to one terminal while the other terminal is connected to the needle. When using the monoterminal or Oudin technic, care must be exercised not to employ too much current or else arcing will occur between the electrode in which the needle is inserted, or the electric cord connecting it to the machine and the hand of the operator. The size of the arc occurring between the needle and the surface will naturally depend upon the distance at which the needle point is held. The limit of the distance across which arcing will occur will in turn depend upon the voltage of the current. There is no object in holding the needle away at any great distance. The usual distance is about one-eighth inch.

Fulguration is much less employed than it has been in the past. It is used only for the destruction of superficial lesions, for instance, port wine marks. Fulguration may be used in the treatment of other conditions where dermatologic practice of today employs medicinal solutions for the superficial destructive purposes. The advantage of employing fulguration instead of these medical escharotics is that the area to be destroyed can be much more exactly limited. The cosmetic results are excellent. It is usually impossible to detect where the destructive action of the fulgurating current has been applied after the destroyed layer is separated off. This separation occurs about ten days after fulguration.

ELECTRODESICCATION

Electrodesiccation is particularly well suited for the destruction of small growths in various parts of the body. The current employed is that secured from the Oudin terminal of the diathermy machine. The settings are usually arranged so that the handle of the choke coil is placed at No. 1, i.e., where the smallest amount of current enters the machine. Where multiple spark gaps are present, usually only one or two are opened. The purpose of arranging the setting as described is to diminish the current, otherwise with its high voltage it may pass directly from the cord and needle holder to the operator. The essential difference in the technic of the application of desiccation as compared with fulguration is in the fact that in desiccation the needle is inserted into the growth to be destroyed before the current is turned on. As a matter of fact, some degree of fulguration also occurs at the same time because as the area becomes dehydrated arcing occurs between the needle and the tissue immediately surrounding it.

Electrodesiccation may be applied with the direct or indirect technic. In the former the needle is connected directly to the Oudin terminal.

Indirect Technic. In indirect technic the patient is connected to this terminal usually by means of a metal bar which he holds in his hands, or else he may be placed on an autocondensation chair or he may lie on an autocondensation pad. The operator then inserts the needle which he holds in his hand into the lesion. He must be careful not to touch any portion of the patient's body or else he will draw the current away from the patient at the region which he touches. It is possible, too, that if the touch be a light one, arcing will occur with an unpleasant sensation both to the patient and to the operator. This indirect technic is only of value when the area to be destroyed is small in its extent and in its depth. If applied carefully, it may be employed without the use of any local anesthetic.

Direct Technic. The most commonly employed technic is the direct one. The action of the current may be intensified if the patient is grounded. This is accomplished by permitting the patient to hold a metal rod which is connected by means of a wire to a waterpipe or a steam radiator. A variation of this grounding technic is one in which a metal ring is held by the operator surrounding the region into which the desiccating needle is inserted.

It is always best to use a local anesthetic when applying any variety of surgical diathermy. These applications are painful, so that if the area is not desensitized by means of a local anesthetic, the patient is apt to move the part away quickly. This motion may be beyond the control of the patient.

There are many advantages in the employment of electrodesiccation for the removal of superfluous growths. The important consideration, from the point of view of the patient, is the completeness of removal without the subsequent detection by any observing eye of any evidence that things were not as nature meant them to be in that area. Electrodesiccation fills this requirement very well. For this reason it is well suited for the removal of growths on the face.

An additional advantage is the extreme exactness with which tissue may be destroyed. This makes the technic particularly applicable for the destruction of areas about the eye. Xanthoma, for example, may be removed by electrodesiccation. If the destructive action has not been sufficiently thorough, it is a simple matter to desiccate the area again at some subsequent period. Small cysts about the eye lend themselves well to the destructive action of the desiccating current.

In treating villous papilloma all that is necessary is to apply the desiccating needle to the tips of the villae. It will then be observed how these finger-like projections become white under the application of the current to the base from which they arise. This type of action holds true for all pedunculated growths, because the current concentration is more or less equal throughout the extent of the pedunculated growth up to its base. Pedunculated polyps can be similarly treated. Corneal ulcers may be desiccated or fulgurated. Granulations on the conjunctiva may be destroyed in like manner.

A third advantage of the use of electrodesiccation is its prevention of bleeding. This is particularly useful in the removal of growths in vascular areas. For tumors in the mouth the use of desiccation is ideal. Papillomas on the tongue may be readily destroyed. The area is first desensitized by topical application of a mucous membrane anesthetic such as a 10 per cent solution of cocaine. Desiccation is then accomplished within a few minutes.

The dehydrating action of this current is valuable for the desiccation of epulis involving only the mucous membranes, and also other growths on the inner side of the cheek, on the uvula and on other regions of the buccal mucosa. Some operators have applied electrodesiccation for the removal

of tonsils. This is a slow method for the removal of these organs. The question of tonsil destruction by means of the electric current will be discussed subsequently. The most common condition for which electrodesiccation is employed is for the removal of verrucae. All varieties of warts can be destroyed by this agency. A few drops of 1 per cent or 2 per cent novocaine are injected into the region surrounding the wart. The desiccating needle is inserted in the growth and the current is turned on by means of a foot switch. The region around the needle is observed to blanch. The current is permitted to flow for a period of about two or three seconds. It is then discontinued, the needle is withdrawn and reinserted into an adjacent part. This process is repeated until the entire growth has been desiccated as evidenced by a change in its color. The tissue turned white by the action of the current will separate away in about two weeks. During that time the region underneath this cover of destroyed cells is preparing to take on the function of acting as a new surface. As a rule, a temporary discoloration appears after the crust of dead tissue separates off. Occasionally this region may assume a pink color which may last for months before it eventually fades.

ELECTROCOAGULATION

Electrocoagulation causes more intensive destruction than electrodesiccation. It is, therefore, the type of current best applied for the destruction of a malignant tissue. It is also employed for the removal of benign growths which are too large to permit the use of the desiccating current. It is the type of high frequency current most widely employed for destructive purposes. Essentially the same hook-up is used as in medical diathermy. The major difference consists in the fact that the current is strongly concentrated at the area which one desires to destroy.

Technic. The technic usually followed consists in applying a large electrode to any part of the patient's body. This electrode is connected to one terminal of the d'Arsonval winding. The other terminal is connected to a very small electrode. The large electrode has been called the inactive one because no major demonstrable change occurs in the tissue beneath it. It is better called the "dispersive electrode" to indicate that the current applied through it is spread over a large area.

The small electrode is called the active one. It is most often a needle. It may be a small metal ball or flat disk, or, for that matter, of any other shape. The flat disk electrodes were among those first used by that pioneer in electrosurgery—Doyen. They have been generally discarded because it is difficult to determine the depth to which the tissue beneath them is destroyed when the current is turned on. It is true that they cover a larger surface than do the needle electrodes, but by means of multiple punctures these latter electrodes can be made to cover as large an area as desired and with much better control of the destructive action. The ball-tipped electrode is usually applied to surfaces where it is desired to stop bleeding from oozing vessels or from a frank bleeder.

When employing the large dispersive and active electrode technic, the electromotive lines of force may be presented as a cone with its apex at the active electrode and its base at the dispersive one. The greatest concentration of current is, of course, at the very tip. There is sufficient concentration of current, however, at a short distance away from the tip to cause destruction of tissue. Beyond this, there is an area where the heat produced is not sufficient to cause an actual destruction but only temporary irritation. In this manner the coagulating effect gradually fades away from the point of the electrode. The depth to which the tissue is destroyed varies with the current strength, the time interval during which it is permitted to flow and with the electrical resistance of the tissues.

The question is usually asked, "How much current shall I use to coagulate tis-

sue?" The best answer is that the questioner experiment with the settings on his own machine while applying the current to a piece of meat. It is possible to answer this question more definitely, as, for example, by saying that such an amount of current should be used as will give a reading of 2000 milliamperes on the hot-wire meter of the diathermy machine when the current is short circuited through the machine. In doing this, the needle connected to one terminal of the d'Arsonval coil is applied directly to the other terminal with the current on. Such a definite answer may be misleading, so that it is far better to acquaint oneself with the factors of current strength and the time period of flow first on a piece of excised tissue (meat) and then on the patient. I do not employ the meter on the machine when applying surgical diathermy for two reasons. One is that, as indicated, the reading on the meter is of little value. The other is to avoid the danger of burning out the meter by accidentally short circuiting it.

The color of the tissue changes to white as it becomes coagulated. This helps to indicate the extent of the destroyed area and serves as a better guide than any definite rule as to the amount of current to be employed and the length of the time during which it is permitted to flow. The coagulated areas will surround the needle and also extend for some distance beneath it. The extent of this distance can best be predetermined by experiment and by experience.

Instead of using the dispersive active electrode technic, it is possible to use two active electrodes, as in my special electrosurgical clamp. The electric current then becomes essentially limited to the plane of tissue lying between the active electrodes. The current does not restrict itself to a straight line connecting these electrodes but also bends outward somewhat, so that the current action is not absolutely confined to the region lying between the electrodes. This principle, however, does permit of a more exact limitation of the destructive action of the current than does the dispersive-active electrode technic.

There are many specially shaped electrodes manufactured to apply surgical diathermy to various parts of the body, as in the nose, throat, urinary bladder, cervix and in other places. All these electrodes are constructed on the principles mentioned. Recently I have had built a surgical electrode surrounded by a hollow tube of insulating material. Suction produced within this tube holds the tissue to which the open end is applied against the coagulating electrode. I have found this electrode particularly valuable in destroying tissue inside of the oral cavity.

The histologic change occurring in tissue during electrocoagulation is the production of hyalinization. Examined through the microscope the tissue is one homogeneous mass. One is not able to differentiate cell protoplasm, cell membrane and the nucleus. This histologic picture has been described by W. L. Clark. He differentiates it from that occurring during electrodesiccation. In the latter, he states that dehydration occurs with mummification of the cells. The identification of cell membrane and nucleus is maintained. Our own experience serves to indicate that the character of the histologic change depends upon the intensity of the current concentration rather than on its special characteristics. A mild coagulating effect will produce a histologic change resembling that described in electrodesiccation, and a strong electrodesiccation will produce a hyalinization of tissue like that described as occurring during electrocoagulation.

Electric Cutting Current. A modification of the high frequency current secured from diathermy machines permits of the cutting of tissue. For this purpose a needle electrode is usually employed. The other terminal on the machine is connected to a dispersive electrode placed anywhere on the body. To the uninitiated it is astonishing to see how a dull needle edge supplied with this current may cut through a piece of meat as if it were a very sharp instru-

ment. The actual cutting effect is secured from the application of the high frequency current. Exactly how has not been determined. The great advantage as compared with the usual surgical scalpel lies in the fact that the tissues on either side of the incision can be coagulated as the cut is made. By changing the settings on the machine the depth of this coagulation can be varied from a thickness of 1 or 2 mm. to several times this number.

In using this technic it is important to cut only with the needle point. All too frequently the surgeon trained in the use of the usual scalpel will attempt to cut with the side of the needle rather than with its point. This does not permit of sufficient current concentration and therefore gives a very unsatisfactory cutting action.

The wall of coagulation formed as the incision is made is sufficient to produce hemostasis of the capillaries and of the small blood vessels. The action of the current is not sufficiently hemostatic to prevent bleeding from the larger blood vessels. These can be tied off by means of a ligature or they may be seized in the jaws of an artery clamp to which the high frequency current conveyed through the needle electrode may be applied. A second of current flow is usually sufficient to cause coagulation of the tissue held within the grasp of the forceps.

If there is some bleeding, coagulated blood may adhere to the needle electrode. It should be removed promptly or else there occurs a marked diminution in the effectiveness of the application of the cutting current. To accomplish this, an excellent procedure is to stick the needle into a wire sponge such as the type sold in hardware stores for the cleansing of pots and pans. Another method is to scrape off the coagulum from the needle by means of some instrument like a forceps. Wiping with a piece of gauze is usually not sufficient because the coagulated blood adheres too firmly to the needle.

The cutting current may be employed by itself or in conjunction with the other modifications of surgical diathermy such as electrodesiccation, and, more particularly, electrocoagulation. This latter combination of the cutting and coagulating currents is the most effective for the surgical removal of new growths. The cutting current cannot be secured from the ordinary diathermy machine. It may be incorporated as a special addition to the diathermy machine or may be purchased as a separate unit. The earliest types of diathermy machines made to cut employed the three elements of the vacuum tube. However, for the past several years, machines making use of the spark gap have been on the market and have proved to be very efficient. They may not give as narrow a zone of coagulation below the cut surface, but to all intents and purposes they appear to be just as efficient. As a matter of fact, the criticism which has been made against the tube machines is that they do not produce as wide an area of coagulation as is frequently desired when employing the cutting current.

Some surgeons are using the electric cutting current even for incising the skin. The great majority of surgeons using surgical diathermy seem to prefer the scalpel for this purpose. The first group of surgeons claim that they can secure primary union in incisions made by the cutting current. The general impression appears to be, however, that to secure primary union the surgical scalpel is the preferable instrument.

When he thoroughly understands the principles involved in the application of electric coagulation and the electric cutting current, the surgeon will soon learn to understand to what lesions he may apply this combination in preference to the use of the scalpel and scissors. These lesions may be either benign or malignant.

The surgeon will employ surgical diathermy for its hemostatic action, for its greater effectiveness in the destruction of malignant tissue, for the ease of its application, for its good cosmetic after effects and for its sterilizing influence.

The hemostatic action of electric surgery makes it particularly applicable for the treatment of conditions developing in vascular tissue. Thus it has greatly broadened the scope of the brain surgeon. It has simplified the cutting of kidney and liver tissue. In gastrointestinal surgery it has the dual advantage of hemostasis and bacterial sterilization. This is of special value when cutting through such tissue as the large intestine in operations for carcinoma.

In the mouth the cutting current is peculiarly effective. Tumors of the oral mucosa may be readily removed without the production of bleeding. This was well illustrated in a case treated by me where sarcoma metastasis in the gums so completely buried the incisor teeth as to make mastication impossible. The friable tissue of the new growth was readily removable with merely a little oozing. The operation for carcinoma of the tongue has been simplified by the application of coagulation and the cutting current. Epulis involving the mucous membrane is another oral condition which is relatively easily handled by coagulation, in contrast to the bleeding which may be controlled only with great difficulty, as many an oral surgeon knows. New growths in the neighborhood of the mouth, such as those appearing on the lip and on the face, are well suited for the application of electrosurgery.

There exists considerable controversy as to whether surgical diathermy or the more usual surgical methods should be employed for the removal of tonsils. There are some who feel that surgical diathermy is the method par excellence; while many others, particularly nose and throat specialists, claim that surgical diathermy has no place in the removal of tonsils. There is no question but that tissue anywhere may be removed by surgical diathermy. The exact application for the destructive action of this procedure to tonsils requires a knowledge of anatomy and of surgical technic which the general practitioner does not usually possess. For the routine case, the usual surgical enucleation of tonsils by a competent specialist is the method of choice. Where contraindications to this technic exist, surgical diathermy may be applied, as for example in cases of hypertension, hemophilia and cardiac diseases, tuberculosis, etc.

For the removal of hemorrhoids surgical diathermy offers an extremely valuable technic, which has many points of superiority when contrasted with other forms of surgery. The hemorrhoidectomy may be performed in the office. There is no bleeding or danger of infection. The after pains appear to be less as also the period of incapacity. For the performance of this operation the ordinary active electrode and dispersing electrode may be employed or else the special two active electrode clamp. The use of this latter instrument facilitates the coagulation of the tissue at the base of the hemorrhoid. In surgical diathermy heat is developed within the tissues by the passage of the high frequency current. In cautery, the heat is applied from the external source. The physical action of these two procedures is entirely different.

Electrosurgery of the Genitourinary Tract. One of the first uses to which electrocoagulation was put was for the destruction of growths in the urinary bladder. Edwin Beer coagulated such growths many years ago. An indication of the flexibility of the procedure is the fact that these growths in the urinary bladder may be destroyed by the aid of instruments inserted through the urethra. A flexible electrode with a ball tip is inserted through the operating section of the cystoscope. It is bent in any desired direction by means of the deflecting device of the cystoscope so that it may be brought into contact with the growth which is to be destroyed. For the destruction of benign growths this is an excellent method. For the treatment of malignancy, however, many urologists prefer to do a suprapubic cystotomy and then to coagulate all the evidences of malignant growths *en masse*. This treatment may, of course,

be combined with the application of radium and of *x*-rays.

During the past few years a new application of surgical diathermy has been made to the urinary tract in the male. This consists in the removal of prostatic tissue obstructing the bladder neck. The extent to which hypertrophy of the prostate may be treated in this manner is still undetermined. There are some urologic enthusiasts who believe that lateral lobe intrusion may be cut away as well as that of the median lobe. The electric cutting current is the one employed for this purpose. It is applied by means of a specially constructed wire loop which is operated through a special urethroscope. The one danger of this operation is the occurrence of postoperative hemorrhage. To avoid this, it has been suggested that a current giving a heavier degree of coagulation than that secured from the tube machines be employed. Although there may be some question as to the extent to which the cutting current may be applied for the removal of prostatic intrusion, there appears to be a consensus of opinion amongst those urologists who have used this method, that it is of extraordinary merit in the removal of median bar and median lobe intrusions. The whole situation is in a state of flux. After it has been more thoroughly developed, it is possible that we may find that urology has made a brilliant advance in simplifying and making safe an operation which is the dread of the many men who require prostatectomy.

Urethral caruncle is a condition which well illustrates the hemostatic advantages of surgical diathermy. It is relatively easy to destroy this by means of electrodesiccation or electrocoagulation. The skilled urologist may also apply surgical diathermy by means of a long, insulated electrode passed through a urethroscope to destroy the glands of Littré. In the female, Skene's glands may be more readily destroyed so as to kill any gonococci which may be existing there. This action illustrates the sterilizing advantages of the application of surgical diathermy. The glands of Bartholin may be similarly destroyed when they are abscessed. An incision may be made with the cutting current through which a ball electrode may be inserted and the entire lining of the gland coagulated.

The cervix uteri is another area of the body which when diseased serves to illustrate well the advantages of the application of surgical diathermy. Carcinoma of this part of the body may first be coagulated and then removed by the cutting current, to be followed by the application of radium or *x*-ray. It is in the treatment of chronic endocervicitis that surgical diathermy has shown brilliant results. The diseased portion of the endometrium may be removed by means of the current applied through a special loop, or the region may be coagulated in narrow strips. By this means, a condition which formerly required the hospitalization of the patient and the performance of an amputation of the cervix may now be more satisfactorily treated in the doctor's office.

Electrosurgery of Malignant Condition of the Skin. It is in the treatment of malignancy involving the skin that surgical diathermy first clearly demonstrated its many advantages. A technic commonly employed is to surround the malignant area with a wall of coagulated tissue. This circumvallation, as it has been termed, is done by inserting the active electrode needle into the healthy tissue surrounding the growth. The current is turned on so as to coagulate the region around the needle. This instrument is then withdrawn and reinserted into the area immediately adjacent. To get underneath the growth a curved needle is used. The result of this technic is to surround the new growth with an area of coagulation extending well into the normal tissue. The malignancy is then removed by means of the cutting current. The advantage of destroying malignancy of the skin by this technic lies primarily in the fact that the danger of the spread of the new growth is greatly minimized

when compared to the employment of the scalpel and scissors. Another advantage is the absence of bleeding, and a third is the subsequent good cosmetic result. Electrocoagulation may, of course, also be used for destroying benign growths and other conditions such as lupus vulgaris. The hemostatic action of the current makes it particularly applicable for the destruction of vascular growths such as angioma.

Electrocoagulation and the electric cutting current are employed for the eradication of malignant growths not only on the skin but in other areas of the body, such as in the breast. These agencies may or may not be used in conjunction with the scalpel and scissors for the initial skin incision and for the dissection of involved lymph glands. This holds true of the treatment of malignancy in other organs. The subsequent application of radium or *x*-ray is a common form of after treatment.

Electrosurgery by Means of the Direct (Galvanic) Current. If the action of the galvanic current is concentrated, it is possible to cause destruction of the animal tissue by its use. The negative pole is usually employed for this purpose. This method has been used in the past for the destruction of growths, but it is employed almost exclusively today for the destruction of hair follicles. Surgical diathermy is being used for the same purpose. A great majority of individuals practicing epilation, however, employ the galvanic current. This current is best derived from a battery so as to avoid the irregularities of current flow when the house current serves as the electric source.

A fine steel needle is connected by means of a cord to the negative pole. The positive pole is attached to a large dispersive pad which may be placed on the patient's back as she lies on the table or to any other part of the body. Good light is essential so as to permit of catheterization of the hair follicle by means of the needle. The current is turned on by means of a hand or foot switch and about ½ to 1 milliampere of current is permitted to flow through the circuit. Within several seconds it is usually possible to see bubbles appearing at the region where the needle presses the skin surface. The current is then discontinued. If the follicle is completely destroyed, it is possible to readily remove the hair much as if it were stuck in butter. While the current is flowing, the patient experiences a disagreeable sensation. She does not feel the actual removal of hair if the follicle has been destroyed. The destructive action of the current is exercised through the production of an alkaline solution at the region of the needle contact. The area of the chin is less sensitive than the region around the mouth. The upper lip, particularly in its section near the nose, is very sensitive. A reaction occurs to this operation. It is therefore inadvisable to remove too many hairs close to each other at one time as the erythema and swelling may become confluent. The epilation sessions should not be applied more frequently than about once in five days to the same area.

THE EFFECTS OF RADIATION ON CANCER

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THE effects produced by *x*-ray and the gamma ray of radium on tumor tissue have been extensively studied grossly and microscopically. Such studies are, of course, more easily and exactingly made upon transplantable laboratory neoplasms.

The changes seen microscopically after radiation of these tumors may be divided into several stages: First, slight hyperplasia; second, a latent period in which no apparent change takes place; third, the appearance of large numbers of abnormal cells, the abnormality being characterized frequently by a swelling of the cytoplasm; fourth, cell death; fifth, replacement of these cells by polymorphonuclear leucocytes and young connective tissue cells; and sixth, scar formation with the inclusion of tumor cells of diminished vitality.

It has been regularly found that young cells, which are actively dividing and particularly those which are undergoing mitosis at the time of exposure to *x*-ray, are more profoundly effected than the more adult type of cell. For this reason moderate radiation of tumors before transplantation will often interfere with growth without interfering with the ability of the transplant to take.

Lacassagne has explained these varying reactions of tissues to radiation, as evidences of the effect of ionization on various parts of the cell complex. He explains that following irradiation of cultures of polytoma uvella the following reactions were observed on cell counts: temporary suppression of growth, abortive anomalies of division and suppression of reproduction. Temporary suppression of growth was observed to occur in most of the individuals, abortive anomalies of division in a much smaller number, and suppression of reproduction and, therefore, eventual death was observed to occur least often. Volumetric estimates of the major cell elements of polytoma uvella were made and disclosed that the percentage volume of cytoplasm in each cell corresponded closely to the number of these organisms which showed a temporary suppression of growth after irradiation. It was also found that the percentage of cell volume occupied by chromatin and the much smaller volume taken up by the centrosome corresponded to the number of organisms, which on count after radiation showed abortive anomalies of development and suppression of reproduction, respectively. Lacassagne assumed from these results that damage to the cytoplasm which on a chance basis would occur most often, produced suppression of growth. Damage to the chromatin and the centrosome were likewise assumed to produce abortive anomalies of division and suppression of reproduction.

An accurate understanding of how and why these changes occur is very much more difficult to conceive, and since it is only by a practical conception of the mechanism of these changes that knowledge can be gained through which more profound tumor cell shock and death may be accomplished, it becomes necessary to attempt such an explanation.

We should first define just what radiation of the order of *x* and gamma radiation is, in what way are they similar and how do they differ? In attempting a practical understanding of these radiations, which are known to be of exceedingly short wave length and high frequency, an analogy to easily understood and more commonly encountered radiation is necessary. *X*-rays and the gamma ray of radium cannot be seen, felt or heard; they have no odor and they produce no temperature change. We

are, however, acquainted with many radiations which can be seen, felt or heard, and if we can establish in our minds an analogy between these radiations and those of *x*-ray and radium, we will have obtained a better idea as to the properties of all radiation. It will then be possible to postulate as to their behavior under various conditions.

The radiations with which we are best acquainted are those of long wave length and low frequency. Sound is perhaps the most easily understood, because of the fact that we can hear it, feel it, and in the case of the lower pitches actually see the movements of the generating body. We are able to study the wave form of these radiations by the attachment of a needle to the vibrating body and tracing its movements on a moving lamp-blacked paper.

Sound, as we all know, is produced by rhythmic vibrations of pieces of matter of such bulk and so fixed as to inherently oscillate at frequencies within the scope of auditory perception. This rhythmic vibration is usually caused by striking the matter to be used at a generator. The force with which it is struck determines the amplitude of the resulting wave. The frequency and wave length, however, are, as stated above, determined by the size of the mass and its fixation to surrounding matter. The larger the body and the looser the fixation, the lower the frequency or pitch produced by striking it; the smaller the body and the firmer the fixation, the higher is the frequency or pitch produced. When the body struck is so small as to set up vibrations which cannot be heard by human ears, the radiation so formed ceases to be called sound. As the bodies become smaller and smaller until we are setting in motion particles of the order of molecules, radiation of the order of radio waves, heat, light and ultra-violet are created. As single molecular groups, atoms, protons and their infinitesimally smaller electrons are set in motion, the inherent frequencies become more and more rapid, the wave lengths become shorter and shorter and the corresponding radiations are known as grenz rays, soft *x*-ray, hard *x*-ray, the gamma rays of radium and finally the cosmic ray.

Presumably, all of the radiations belonging in the group known as *x*-ray, gamma ray and cosmic radiations are formed by the rhythmic vibrations of electrons, and the shorter the wave length and the more rapid the frequency, the more firmly fixed the generating electron must have been to produce them.

We, of course, have no organ of sense which can perceive radiations of greater frequency or shorter wave length than those of the violet end of the light spectrum. But by various indirect means we know that these radiations behave in a manner analogous to those which we can sense by one organ or another.

In the generation of waves of progressively higher frequency and shorter wave length, the body used as the instrument of percussion, must become progressively smaller as the bodies set in motion become smaller. Therefore, when electrons become the generating source, other electrons must be used to strike them. In the *x*-ray tube, electrons are created in a vacuum by disintegration of atoms in a wire filament as it is heated to incandescence. The greater the heat the more rapid is this disintegration, and the greater the number of electrons so made available. By impressing a high voltage negative charge on this filament and a positive charge on an adjacent dense metallic target, these electrons are driven across the space between the filament and the target and forcibly strike the atoms in this target. The impact of the bombarding electrons sets up radiation of varying wave lengths and frequency, depending upon the size and tension of the part of the atom which is struck, and the velocity of the bombarding electrons. The greater the electrical stress between the filament and the target, the more violent the impact between the electron freed from the filament and the electrons in the atoms of the target, the shorter is the wave length of the resulting radiation. However, the bom-

bardment also results in the formation of heat or infra-red rays.

In the case of radium (gamma) radiation, the bombarding electrons are freed in the atoms of radium because of their inherent instability, and the impingement of these freed electrons upon others creates the gamma radiation.

Now, in what way do these short wave length radiations affect living tissue, and particularly living, malignant tissue? Individual cells and some of their larger component parts are the smallest forms of tissue which we can see directly with a microscope. We know, however, that even the smallest visible parts are made up of a vast number of atoms which are, of course, ultramicroscopic. The structure of some of these atoms is simple, and of others, exceedingly complex. All are made up of a single nuclear mass with a varying number of surrounding electrons. Each electron has its own orbit about the nucleus in a way similar to that which exists in our planetary system, wherein each planet, analogous to the electron, describes its orbit about the sun, which is, in turn, analogous to the atomic nuclear mass. Some of these electronic orbits are more definitely fixed than others, and the more fixed the orbits and the greater the tension with which they are held to their paths, the more stable is the atom. It is obvious that any serious derangement of electronic orbits in these complex atoms changes the character and properties of the atom, and when the aberrations are carried far enough, or electron loss takes place, the atom loses its original identity and becomes a different element. When sufficient elemental changes have taken place particularly in critical portions of the cell, life ceases to exist.

In malignant tumor cells, which are growing and undergoing mitosis at short intervals, atomic and molecular rearrangements are continually taking place due to the necessarily rapid chemical changes which must accompany mitosis. In such cells a relative atomic instability is present, at least during the period of mitosis. On the other hand, cells which are physiologically inactive are only occasionally undergoing mitosis and, therefore, chemical changes can be expected to be slower, and the whole cell complex more stable.

How does this variation in atomic structure, activity and stability affect the subject which we are considering, that is, the reaction of tumor cells to radiant energy?

Let us construct a relatively simple atom on a scale which we can readily appreciate. The electrons in this atom are moving along fixed orbits about the nucleus or proton group. The force holding the electron in its orbit determines the stability of the atom. Since the loss of one electron changes the orbits of others in the same atom and alters the number of component parts, the atom becomes another individual. Assume now that the electrons in an atom are suddenly confronted with an outside electromagnetic force, pulsating in character and timed to a frequency which would be the inherent frequency of one of these electrons, if it were struck by another body of like dimensions. The electron is immediately set into sympathic vibration. If this vibration is sufficiently violent, the relationship of the electron to its orbit may be disturbed, and, in turn, if this disturbance is of sufficient magnitude, the force holding the electron to its orbit is overcome. In this event, the electron becomes a free agent, shoots off into interatomic space, may become a part of a neighboring atomic system or strike an electron or proton group in another such system. This impact sets up further radiation by producing oscillations of the body so struck. If forceful enough, the collision may dislodge the second electron and a second atom will be thus changed.

When a sufficient number of these changes have taken place, suppression of growth, disturbed reproduction or immediate cell death occurs, depending upon the particular intracellular structure which has been affected. It also follows that the conglomerate making up the cell is, the

more easily and quickly its destruction is accomplished.

In considering this subject and in building up these analogies, a much more simple concept of atomic structure has been assumed than that which actually exists. It may, however, be fairly said that no matter how complex one assumes atomic structure to be, and no matter how many other minute particles of matter are later found to make up the atom, the basic principles, as cited above, should still apply.

Having arrived at a workable explanation of radiation, and also a concept of the effects of radiation on living tumor cells, what is the clinical value of this data? It has been shown by experimentation, that a sufficiently large quantity of radiant energy will destroy any form of living matter. We can, therefore, assume that by the application of sufficient radiant energy we can effect the complete destruction of all malignant tumor cells regardless of their type, origin or biologic activity. We cannot, however, assume that in delivering this amount of radiant energy to a malignant tumor we will not at the same time destroy so much normal tissue about the malignancy as to cause the death of the host of the tumor. In any location where complete destruction of surrounding normal tissue can be accomplished without affecting vital structures, radiation can be expected to cure the cancer locally. Similarly, wherever a malignant tumor can be safely and completely excised surgically, a cure is effected. It is unfortunately the fact, however, that many cancers, particularly those which are deep-seated, either lie within, or are adjacent to structures so vital to the life of the patient, that the tremendous dosages of radiation which are necessary to the complete destruction of the cancer cannot be applied without at the same time destroying these vital structures. Similarly, it is often true that while the tissue in which the primary cancer tissue developed may be resectable surgically without destroying the individual, there are microscopic or gross extensions from the primary site of the tumor because the extension involving these vital structures are not resectable. We should, however, remember that the extensions of the tumor cells into the lymphatic and other adjacent tissues are, of necessity, young, and, therefore, cells of a highly anaplastic, undifferentiated, rapidly growing and consequently radiosensitive type. In many instances we can destroy much of the local cancer metastasis with dosages well within normal tissue tolerance. Such reduced cancer involvement then becomes operable, and a cure can be accomplished by radical surgery in conjunction with reasonable amounts of *x*-radiation or radium radiation.

In explanation of the selectively destructive action of radiation on malignant tissue, we must assume that the cell which originally bore the malignant tissue was at its very inception a normal cell, and that for some reason unknown, it entered upon a career characterized by an unlimited power of multiplication. This characteristic was transmitted to its descendants, and as each succeeding generation appeared, the cell growth continued uncontrolled. At the same time, obeying in a sense Mendel's law, some of the daughter cells developed and arranged themselves after the pattern of the original ancestor and the cell group in which this ancestor existed. Such cells behave in a tumor very like the original nonmalignant and normal cells from which the tumor developed. Other daughter cells develop characteristics similar to the undifferentiated embryonal cell from which the involved organ arose. Between these two extremes, all possible biologic, histologic and physiologic differentiations may occur.

The sensitivity of any cell to irradiation is dependent largely upon its biologic activity. Ordinarily, the greater this activity, the larger is the nucleus proportionate to the total cell mass. It is well known that the nucleus contains most of this matter which is vital to the life and reproductive activity of the cell. Thus, purely on the

theory of chance, the possibility that the nucleus will be struck by a moving electron is greater in more active cells, and the possibility of vital damage is proportionately increased. Ordinarily, the same factors which were responsible for the proportionately greater mass are associated with a greater chemical activity and consequently greater atomic instability within the nucleus. This, in turn, renders more likely the disruption of component atoms by the influence of surrounding electromagnetic forces.

Clinically, then, if we are certain that a malignant tumor is contained entirely within a certain area, and that there have been no blood-borne metastases, we can cure this tumor by radiation if we destroy all of the surrounding and immediately underlying and overlying normal tissue. If this destruction is compatible with the life of the host, the patient can be cured of the malignancy. Similarly, if the site of the tumor and its surrounding tissues can be completely excised surgically, and there has been no blood-borne metastasis nor microscopic extension of the malignancy beyond the site of resection, the patient can be cured of cancer. If, however, the tumor has extended, through the lymphatics or by direct extension, into vital structures, the loss of which by destructive effect of radiation or excision would not be compatible with the life of the patient, then that cancer cannot be cured by radiation or by surgery. When curable by neither radiation nor surgery, a combination of these procedures may be used. In the first place, radiation in an amount which can be easily borne by the surrounding normal tissues is administered. In many instances, all of the malignant tissue which has extended beyond the area which can be readily excised is of a highly undifferentiated and, therefore, radiosensitive type; and this is particularly true where these cancer extensions are microscopic, and where the daughter cells deposited in regional lymph nodes have not had the opportunity to develop throw-backs to the normal highly differentiated and therefore, radioresistant type. If, therefore, extensive courses of radiation are given to all the tissues where the cancer might have extended beyond a point which is resectable, and the surrounding normal tissues have not been seriously handicapped by such radiation, these outlying sensitive cancer cells can be destroyed completely, leaving for the surgeons only resection of the primary tumor and its immediately adjacent metastases to complete the cure. A third possibility must also be considered where blood-borne metastases have taken place before the patient is observed. In these instances, quite naturally, only palliation can be expected from any known form of therapy. Depending upon the type of case, these procedures may be either surgical, radiological or a combination of the two.

In this essay we have endeavored to describe in a practical, simple way the effects of radiation on living tissue. An attempt has also been made to put on a biologic basis the necessity for cooperation between the radiologist, the surgeon and the pathologist in the handling of all cancer cases.

EARLY DIAGNOSIS OF CANCER

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IN daily practice, the physician is often confronted with the diagnostic problem raised by the patient who comes to him in response to the dictum, "See your doctor early in all cases of doubt when some abnormal growth is noted." While there is no standard method whereby early cancer can be recognized or a proved biologic test by which its beginnings can be identified, to the careful physician certain clinical manifestations do indicate abnormal tissue reactions which suggest the probability of cancer.

The increased effectiveness of surgery and radiation in curing cancer is not compensating for the increased incidence of cancer. There has been no appreciable reduction in the annual cancer death rate. As a matter of fact, it is on the increase. The fundamental problem of cancer control is not million volt *x*-ray machines, cyclotrons, freezing or boiling. It is still *early diagnosis*. Because of the high curability of early cancer, it is the responsibility of every doctor to become a specialist in the recognition of the early manifestations of cancer.

Cancer may appear in visible, palpable form or manifest itself as an abnormal physiologic phenomenon. Definite proof rests with substantiated pathologic and/or radiologic examination. In a general way, malignant conditions may be suggested by odor, mass, growth, induration, fixation, bleeding and interference with the normal physiologic functioning of vital organs.

Odor. A peculiar cadaverous, gangrenous odor associated with persistent ulceration suggests cancer. The best application of this principle is in oral lesions where an ulcerated carcinoma may emit this odor as distinguished from a luetic sore.

Mass. The continued presence of a hard mass growing steadily in an unusual locality and fixed to surrounding or underlying tissues suggests neoplastic development.

Induration and Fixation. In tissues normally soft and movable, unusual induration and fixation which persist over a long period of time without resolution point to the possibility of cancer.

Bleeding. Persistent hemorrhage always suggests abnormal conditions. When it occurs with unusual periodicity or without following an apparently normal physiologic course, a malignant origin is to be suspected.

Interference. An abnormality that interferes with the physiologic functioning of normal channels of ingress or egress may suggest malignancy.

While cancer is a destructive disease, its effects in the early stages may be insidious, showing few of the more pronounced reactions usually associated with the advanced case. In its early stages one cannot note anemia, loss of weight, retracted nipples (in breast lesions) or ribbon stools (in rectal cancer). It is before these pathognomonic changes are perceived that we must recognize the symptoms of malignant change.

Examination for cancer must be carried out painstakingly and with patience. The history is important. A persistent interference with normal physiologic functioning that gradually increases the distress of the patient, e.g., difficulty in swallowing, first slight, later more marked, with increasing change in the character of the food that may be swallowed, suggests a lesion in the esophagus. Careful inspection of a new growth or sore not tending to heal

may reveal an early malignant change. In some cases transillumination of a growth may show alteration of normal conditions, arousing suspicion of cancer. Palpation often gives a clue to malignancy, for cancer growths are often infiltrating and stony-hard. Where doubt exists, a biopsy of the growth may prove the condition. In early cases the biopsy itself may effect a cure by the radical removal of the small lesion.

Skin. The most common types of skin cancer are the basal cell and the squamous cell epitheliomas. While diagnosis by histologic study is quite easy, clinical differentiation is not always possible, especially in the early stages of the disease. In most instances basal cell lesions are found on the skin of the face or head in older people and are frequently multiple. The ordinary basal cell type of skin cancer may begin as a nodule which slowly grows, ulcerates and produces a small crater with rolled, pearly, indurated edges. Sometimes it is hidden under a persistent scab which when torn off leaves a new peeling scab on a granular base. Often, especially in older people, the cancer is a transformation of previously existing keratosis so often seen in the aged. When the lesion grows and extends rapidly with ulceration and destruction of the superficial and deep tissues, it is probably the rodent ulcer type of basal cell cancer. A keratotic lesion that bleeds readily, that becomes indurated and does not heal under treatment with some bland ointment always presupposes cancer of the skin. Basal cell lesions rarely metastasize.

Squamous cell epitheliomas are more serious lesions. They may appear anywhere on the skin, including that of the appendages. They grow fast and ulcerate rapidly. The gross signs are similar to those described with basal cell cancers; namely, an elevated new growth with rolled, whitish, pearly edges. They differ from basal cell lesions in that they invade the adjacent lymphatics to yield a deep induration and frequently extend to the first line of lymph node drainage. These characteristics, however, do not aid much in differentiating one from the other, and frequently only histologic study will prove of diagnostic aid. Occasionally in a slow-growing, keratinizing squamous cell carcinoma, the outer, horny layer of epithelium will not be desquamated and will pile up to form a cutaneous horn. A basal cell epithelioma does not form such a horn.

Oral Lesions. Leukoplakia itself is not a sign of malignancy, but occasionally a malignant ulceration is engrafted on a persistently irritated, long standing leukoplakia. Less commonly, a leukoplakic patch may become thickened and infiltrate the deeper tissues without ulceration.

Tuberculosis of the lip occasionally is seen but in practically every case it is associated with active pulmonary tuberculosis. Malignant lesions occur most often on the lower lip, appearing as an indurated ulcer at the mucocutaneous junction that persists and does not heal under simple measures. When associated adenopathy is palpable, the diagnosis of malignancy is apparent. The history of a sore beginning with a smoker's burn is suggestive, too, when the ulceration following such trauma fails to heal under simple care. It must be remembered that the presence of syphilis does not lend benignity to a persistent lesion; for this disease and cancer can coexist in the same individual. Likewise a positive Wassermann test does not necessarily signify that a persistent lesion is syphilitic. It may be malignant as an added condition in this patient.

Because of the color, recognition of a melanoma is obvious. To distinguish a benign from a malignant melanoma, fixation, rate of growth and change in character must be evaluated. A benign melanoma may be present for many years and then give evidences of sudden rapid growth, encrustation, bleeding, increased or decreased pigmentation, change in contour, deeper fixation, all signs of a malignant change. A persistent soreness of the tongue, cheek or gums with painful swallowing and foul odor of the mouth often suggest a

malignant condition. The tongue is the most common seat of cancer in the oral cavity. In a large number of cases intraoral cancer is associated with syphilis and in many instances may occur superimposed upon an old leukoplakia. In nearly all cases, poor dental hygiene, jagged, rotten teeth or ill-fitting dentures tend to be the exciting cause of ulceration and cancer. A persistent ulceration or infectious process that does not heal readily under antiseptic or medical treatment, including the removal of irritation, should be suspected of malignant change and tested by biopsy.

A tonsil harboring a malignant process will appear, in the early stages, as a diffusely enlarged gland. Soon, however, it ulcerates and is covered with a dirty-looking hemorrhagic coat. If discrete and hard neck nodes are present, the diagnosis of cancer is quite evident. If both tonsils are persistently swollen and there is generalized adenopathy throughout the body especially in a young person, lymphosarcoma should be suspected. Biopsy should be employed to sustain the diagnosis of malignancy.

Lesions of the larynx offer a difficult problem in diagnosis. Not all hoarseness is due to cancer nor is every growth on the cords malignant. However, a persistent hoarseness warrants careful investigation of the larynx. A papillary growth which ulcerates, recurs after excision and invades surrounding structures, is malignant. Any persistent ulceration with associated adenopathy makes the diagnosis of cancer of the larynx most reasonable. Carcinoma of the extrinsic larynx may not involve the cords and hence be unattended by hoarseness. Such lesions should be confirmed by biopsy. *X*-ray examination of the chest and blood serology for syphilis may help identify the lesion.

Lymphaenopathies. Generalized lymph node enlargement with or without splenomegaly gives rise to the differential diagnosis between Hodgkin's disease, lymphosarcoma, leukemia, giant follicular lymphadenopathy, polymorphous cell sarcoma and sometimes syphilis. Only a leukemia can be positively identified by a simple office procedure of blood count. To establish the diagnosis of one of the other conditions, biopsy and blood test must be performed. When available, *x*-ray therapy is a convenient therapeutic test.

Localized lymph node enlargement direct attention to the limited anatomic situation. Nodes in the neck may be congenital, such as lipoma, cystic hygroma, cysts or angiomas; they may be benign infectious nodes, as parotitis, tuberculosis, or lymphadenitis draining an infectious area. A more positive hardness of a node must raise the suspicion of a metastatic focus, such as, the superficial and deep cervical chain draining the head and neck or bronchus; a Virchow's node from the gastrointestinal tract, axillary node from the breast, etc.

Breast. Cancer of the breast occurs mainly in women. Usually the first symptom of which the patient complains is a "lump" felt somewhere in the breast. Associated symptoms may be discharge from the nipple, pain in the breast or arthritic pains described as neuritis, sciatica or lumbago. Obviously not every lump in the breast is malignant but it is a good rule to consider such abnormal findings malignant unless proved otherwise. The importance of early diagnosis in breast cancer must be recognized when one considers that only in cases in which the tumor is strictly confined to the breast is it possible to promise a complete cure. When node metastasis is present even in the operable cases, the chance of permanent cure is reduced appreciably.

Inspection offers an aid in diagnosis. An irregular alteration in the contour of the breast, marked engorgement of the superficial veins, boggy edema of the breast, elevation and retraction of the nipple, orange peel skin—there are all suggestive signs of a malignant process, and in combination may be pathognomonic. Obviously, palpation offers the greatest help in establishing the diagnosis of breast

dyscrasias. A soft, freely moveable encapsulated nodule in one or both breasts is probably benign, but must be so proved by hystologic test. Masses composed of dilated ducts with fibrous strands, usually occupying the outer quadrants with a contributory history of pain at the time of the menstrual periods, are benign. A hard tumor localized or spreading in ameba-like fashion, not tender to touch, must arouse a strong suspicion of cancer. Such a tumor accompanied by information gained by observation, as cited above, is certainly cancer. A hard node in one axilla is positive substantiating evidence. Slight puckering and adherence of the skin to the underlying mass is suggestive of cancer.

Another diagnostic procedure (Scott) which has proved useful even in very early cases of breast cancer is as follows: Since cancer produces thickening of the interlobular fascia of the breast so that pull or pressure causes them to make depressions in the skin, a ray of light striking tangentially across the breast in a darkened room makes these depressions appear as shadows. In some instances this is a much more dependable early sign than retraction of the nipple and appearance of nodes which are normally late indications. The glancing light casts an irregular shadow proportionate to the size and depth of the depressions. With practical experience this test should prove quite accurate as an early diagnostic procedure. A rapidly growing, hard, very large tumor with pain suggests sarcoma.

Occasionally, tuberculosis of the breast is uncovered. The lesions are multiple, painful, fluctuant and ulcerating. Systemic symptoms as fever and night sweats are present. A primary infection can be isolated elsewhere.

Transillumination is of little assistance in diagnosis. It does not offer conclusive evidence regarding the benignancy or the malignancy of the tumor. Roentgenography of the breast is as yet too indefinite to warrant reliance on it for differential diagnosis. In all cases surgical excision of the tumor with pathologic study must be employed to confirm the diagnosis.

Lung. Cancer of the lung yields a wide variety of symptoms so that no specific criteria can be established. Especially is this true in early lesions. The most common symptoms are persistent, dry, irritative cough with pain in the chest. The cough is persistent and fails to respond to the usual medical treatment. Sputum may be scant or profuse, bloody or clear. Hemoptysis is an alarming symptom. The lesion usually appears in people of middle age. In early occlusion of the bronchus, wheezing, asthma-like breathing occurs along with an aching constriction of the chest. Physical signs are not significant in early stages. Advanced involvement may cause pleuritic signs, too. Fever due to secondary infection is present in many cases. Fluoroscopic, roentgenographic and bronchoscopic examination may prove the lesion. At times a metastatic node in the axilla or supraclavicular area may suggest the diagnosis.

Gynecology. Early symptoms of ovarian cancer are not often encountered, as this tumor is silent until it reaches a large size. Irregularities in the menstrual cycle, loss of weight, gradual insidious enlargement of the abdomen and occasional pelvic distress may be the symptoms deserving of investigation. Age is no criterion, since young females commonly have ovarian cancer. Advance of the disease is usually accompanied by pelvic pain, ascites, cachexia and pain.

Cancer of the cervix is the most common type of malignancy in the uterus. The most frequent and early symptom is bleeding. Any abnormal vaginal bleeding requires investigation. The early signs of cervix cancer are difficult to visualize. The iodine test, Schiller's test, is based on the normal action of glycogen in the presence of iodine. Cancer tissue is free of glycogen and therefore the tissue so involved does not show the characteristic brown iodine

stain. Unfortunately, this test is not effective in all instances. Foul-smelling, bloody discharge associated with an irregular ulcerated lesion, postmenopausal bleeding and irregular premenstrual bleeding are all suggestive of carcinoma of the cervix. A friable granulating ulcer with induration, readily bleeding on manipulation, is a presumptive cancer. Induration, which is a later sign about an ulcer of the cervix, suggests malignancy. Biopsy, however, is necessary in all cases to establish the diagnosis.

Cancer of the uterine corpus is not easily recognizable in its early stage. Abnormal bleeding is the most common complaint. It may occur before or after menstruation. When functional causes are ruled out, persistent abnormal bleeding suggests malignancy and must be ruled out by curettage biopsy. Pain, uterine enlargement, foul discharge and associated pelvic phenomena are all late symptoms.

Prostate. The prostate is the second most frequent organ involved with cancer in the male. The disease in this area is slow-growing and often gives very few symptoms. The tumor may be rather small and confined and yet widespread, distant metastases may occur. About one-third of all cases metastasize to the skeleton. The diagnosis in the early stages is not readily made because the symptoms are not marked. The earliest symptoms are those usually associated with urinary discomfort. A rectal examination may reveal an enlarged prostate. Usually the organ is hard and encapsulated. When it has broken through and infiltrated the surrounding tissues, it is already in the advanced stage. Frequency and urgency of urination may be the only symptoms. Occasionally slight bleeding on urination may indicate extension into the bladder or simple ulceration. In a man of the cancer age, a hard, irregular prostate with urinary discomfort and complaints of rheumatism in the pelvis suggest cancer of the prostate.

Bladder. Lesions of the bladder may be benign or malignant. Papillomas, which give symptoms somewhat similar to cancer, are commonly the precursor of cancer. The earliest symptom is hematuria. Occasionally urinary blockage may occur especially if the tumor is in the bladder neck. Metastases occur late in malignant bladder conditions. This helps to differentiate the hematuria due to renal involvement in which metastases are early and common.

Kidney. Cancer of the kidney is the most common tumor of the kidney. Cancer of the kidney metastasizes early and is widespread. The symptoms, aside from hematuria in the early stages, are not significant. Occasional pain and hematuria occur. At times the symptoms are noted only because of the metastatic involvement, such as lung or bone. In children, the kidney neoplasm most commonly seen is Wilm's embryonal adenosarcoma. In this case the symptoms begin early in life with a constant pronounced swelling of the abdomen. A tumor mass is usually felt and there may be urinary disturbances. The *x*-ray examination in kidney tumors may at times identify an early lesion.

Testicular Tumor. These tumors are unilateral, hard masses which grow slowly with very few symptoms. Pain in the scrotum may be the first sign of an involvement. Aspiration biopsy may permit identification of the tumor. Even in early suspicious cases the Aschheim-Zondek test may be significant and helps confirm the diagnosis. Metastases are early and widespread.

Gastrointestinal Tract. The most common site for cancer in the human is in the gastrointestinal tract. However, the symptoms associated with cancer in this part of the body are rarely noticeable in the early stages of the disease.

Age is no longer considered an inexplicable defense against the occurrence of cancer of the stomach for we now find cancer present very often in the younger adult. The earliest symptoms are those of indigestion. A long standing, con-

stant indigestion with loss of appetite, some weakness and possibly eructations of blood-streaked mucous should suggest the possibility of an organic lesion. *X*-ray examination may at times reveal an early cancerous growth. The gastroscope may permit the visualization of a lesion in the stomach. Gastric analysis showing absence of HCL and the presence of some blood is suggestive. Certainly, the most important dictum to be remembered is that the sudden appearance of dyspeptic symptoms in an individual of the cancer age must be considered due to cancer until proved otherwise. Unless a mass is palpable on abdominal examination, reliance must be placed on symptomatology for a presumptive diagnosis of cancer of the colon. A lesion on the right side should suggest itself by an unexplained anemia and loss of weight. A left-sided lesion may produce melena, constipation or diarrhea. In any case, the suggestive lesion must be corroborated by competent *x*-ray examination.

Cancer of the rectum is a common lesion often recognized only too late for cure. Any symptom referable to the gastrointestinal tract below the stomach deserves a finger examination of the rectum. In that way many early cancers will be identified. Obviously, bleeding from the rectum calls for a digital and proctoscopic examination. The classic symptoms of alternating diarrhea and constipation, ribbon stools and pain represent an advanced stage of the disease.

While cancer in its early stages is usually symptomless, by careful attention to details in history and physical examination, the attentive physician may often detect an early neoplastic development which is readily curable.

BOOK REVIEWS

MINOR SURGERY. By Frederick Christopher, M.D. With a Foreword by Allen B. Kanavel, M.D. Fourth Edition, Reset. With 639 Illustrations. Philadelphia, 1940. W. B. Saunders Company.

This standard textbook first appeared in 1929 and other editions appeared in 1932 and 1936. For a decade it has been one of our favorites, and to us this fourth edition is both timely and welcome.

There has been no end of discussion concerning the line of demarcation between major and minor surgery. There are those who claim there is no such thing as minor surgery. We feel the author has put the problem tersely and clearly in the first paragraph of his Preface to the First Edition. He wrote, "*Minor Surgery* is the surgery which has a low mortality; which requires but few assistants; which generally is done in the hospital outpatient department or in the office. It includes the large majority of surgical cases; the every-day surgical conditions. All minor surgery potentially is major surgery; often a distinction cannot be made."

We learn from the Editor of The American Journal of Surgery that in the future instead of a Minor Surgery Number he will call it "Every-day Surgical Conditions." But this is an aside.

Certain books are written, appear, reappear in new editions, and one day not only have they become standard but a very part of our medical structure. When we wish to refer to a chapter dealing with a minor surgical problem, we naturally and unconsciously turn to Christopher's book. It is not that we know the author or that we are one of his friends (we would not know him if we sat together at a lunch table); it is not because we have not read similar books on the subject; but it is because we believe it is the best and most complete work on the subject we have today. And so to us this fourth Edition is both merited and welcome.

A METHOD OF ANATOMY. DESCRIPTIVE AND DEDUCTIVE. By J. C. Boileau Grant. Second Edition. Baltimore, 1940. The Williams and Wilkins Company. Price $6.00.

This book was first published in 1937 and was reprinted in 1938. Now a second edition is offered the profession. When a reader goes through this work, the reason for its popularity will be apparent.

In this second edition an introductory section on the systems of the body has been added and certain hiatuses have been filled. Various sentences and paragraphs have been reworded, a hundred new illustrations and diagrams have been added and the index has been enlarged. It is a solid, well written book.

Medical students and surgeons will find "A Method of Anatomy" invaluable as a textbook and a reference work, which is sure to enjoy a long life of usefulness.

A TEXTBOOK OF HISTOLOGY. By Harvey Ernest Jordan, PH.D. Eighth Edition. New York, 1940. D. Appleton-Century Company. Price $7.00.

Dr. Jordan's Histology is an old standby and friend. For nearly twenty-five years it has been familiar and of great value to thousands of medical students. One sees it today on the shelf in laboratories throughout the land, and we sincerely wish that we had had a book as well and as interestingly written when we were a student. There is no need to tell what the book is about. It is a textbook on histology and covers the subject thoroughly. The profuse illustrations are of a high order of excellence and from the publisher's angle it is typographically satisfying. The book is readable and of a size that makes handling easy; the type is large and clear and the paper stock very good.

So this Textbook of Histology by Harvey Ernest Jordan is a most excellent work from every viewpoint. A book must be good to go into eight editions over a span of twenty-four years, and medical students and practitioners of medicine are fortunate they have such a book for study and reference.

DIAGNOSIS AND TREATMENT OF HEAD INJURIES. By Sidney W. Gross, M.D. and William Ehrlich, M.D. Introduction by Percival Bailey, M.D. New York, 1940.

Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers. Price $5.00.

This is a timely and worth while book. It is *timely* because an authoritative book on this topic is welcome in this age of head injuries due mainly to the automobile. Four or five decades ago the incidence of head injuries was insignificant as compared with their everyday, commonplace occurrence at the present time. It is *worthwhile* because the authors know their subject, have had no end of clinical experience with this type of case and present their thesis with clearness and restraint.

The contents embrace applied anatomy of the head, intracranial physiology, the mechanics and pathology of head injuries, method of examination, classification of head injuries, principles guiding the treatment of head injuries, injuries of scalp and skull, extradural hemorrhage, traumatic subdural hematoma, fractures of the skull with involvement of the paranasal sinuses, mastoids and middle ear, suppurative cranial and intracranial disease resulting from trauma, gunshot and other penetrating wounds of the head, cranial nerve injuries, convulsive seizures following head injuries, surgical technique, complications and sequelae of head injuries, head injury and disease of the nervous system.

There is a bibliography, an index and many valuable illustrations. It is an excellent book.

Bacillary and Rickettsial Infections Acute and Chronic. By William H. Holmes, M.D. New York, 1940. The Macmillan Company. Price $6.00.

This is a textbook of 676 pages by one who has had thirty years of medical practice and twenty-seven years of teaching.

The author tells us in his Preface, "In the preparation of this book it was desired to cover each subject with a reasonable degree of completeness consistent with its social, medical and historic importance, without producing an exceedingly bulky and expensive volume. This was accomplished by omitting illustrations and by the decision not to attempt consideration of all the infectious diseases in a single volume. The present volume, therefore, deals only with the bacillary and rickettsial infections, leaving the virus diseases, and the infections of coccal, spirochetal, and protozoal etiology for subsequent presentation."

This book covers: the pasteurella infections, the rickettsial infections of man, the brucella infections, the enteric infections, bacillary intoxications, hemophilus infections, the mycobacterial diseases, and miscellaneous bacillary infections (anthrax, glanders, melioidosis, etc.). There is a bibliography at the end of the chapters and the index is ample.

The reader will be pleasantly surprised when he reads this work to note that he has come in contact with a new kind of textbook, an experience both refreshing and stimulating. It goes without saying that the author is an authority on the subject and the text matter comprises the last, up-to-date thoughts on this subject.

Abdominal Operations. By Rodney Maingot, F.R.C.S. (Eng.). Two Volumes. New York, 1940. D. Appleton-Century Company.

The author tells us in the first sentence of his Preface that "This book is intended to present a detailed consideration of the technique of modern abdominal operations." In addition it deals with the choice of operations in the individual case, "the difficulties and dangers which sometimes arise during the conduct of operation, the pre- and post-operative treatment, the immediate and remote results of the various measures described, the clinical, pathological and other aspects of most of the destructive lesions of the abdominal viscera, and many problems in abdominal surgery." This is the blueprint. From it the author has done two worth while, up-to-date volumes.

Volume I deals with abdominal incisions, stomach and duodenum, spleen, pancreas, gallbladder and bile ducts. Volume II deals with liver, veriform appendix, peritoneum, mesentery, omentum, external abdominal hernia, intestines, and postoperative complications. There is an index to the whole. The illustrations are profuse, well done and some are in color.

Interns and surgical residents are sure to find this work of the greatest value and help to them. We hint that it would be an excellent investment on their part to own these two volumes. Surgeons will enjoy browsing through its pages and are sure to gather many useful items along the way. We rate it most highly.

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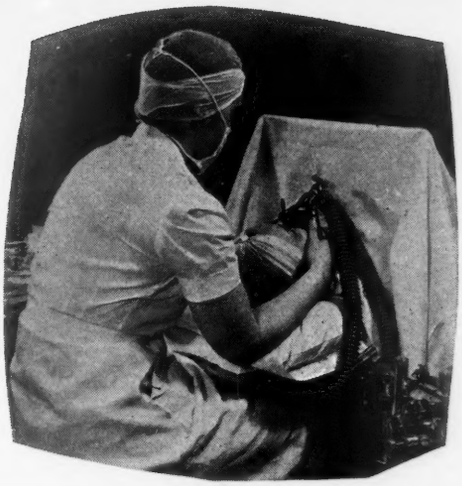

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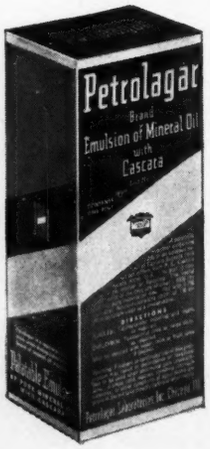

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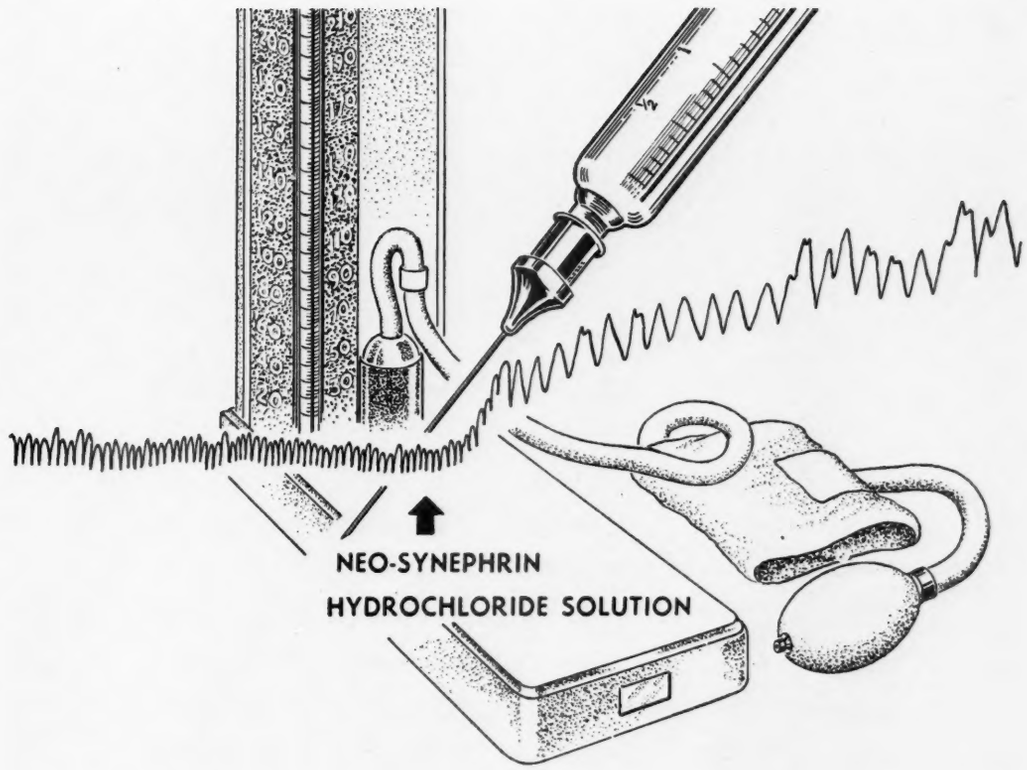

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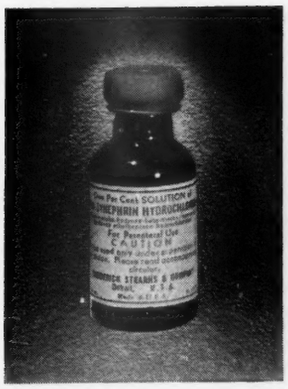

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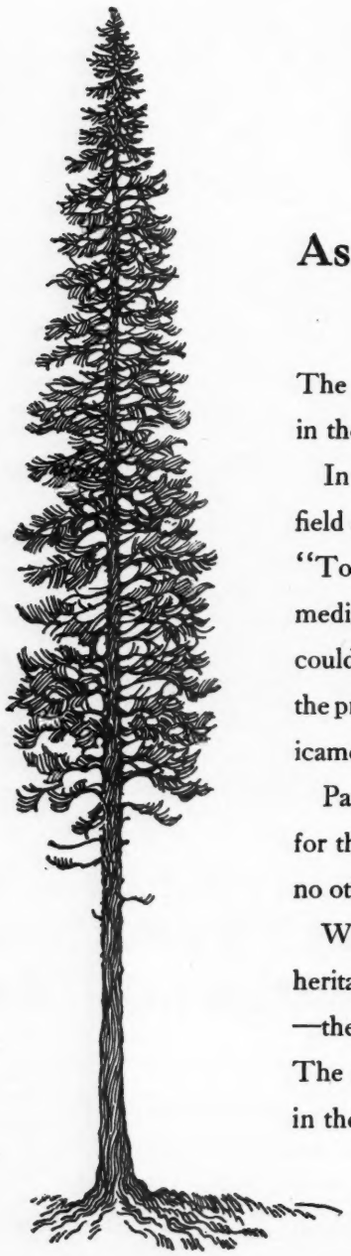

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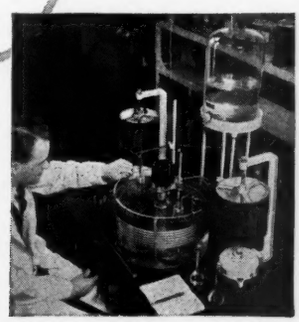

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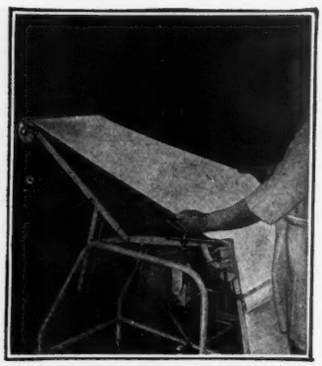

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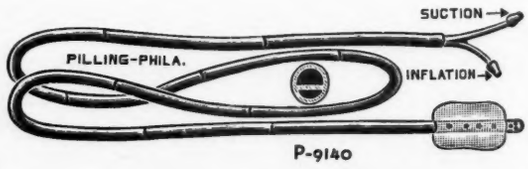

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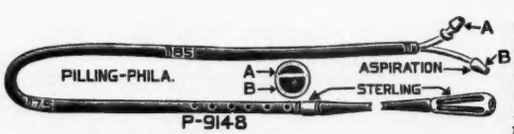

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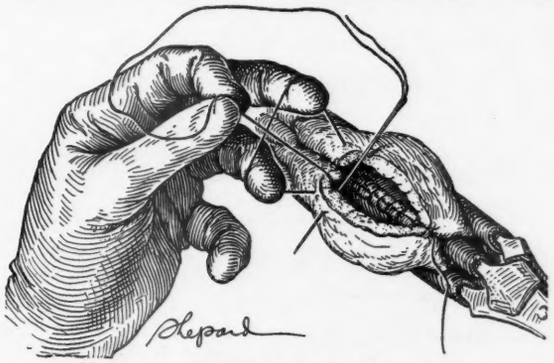

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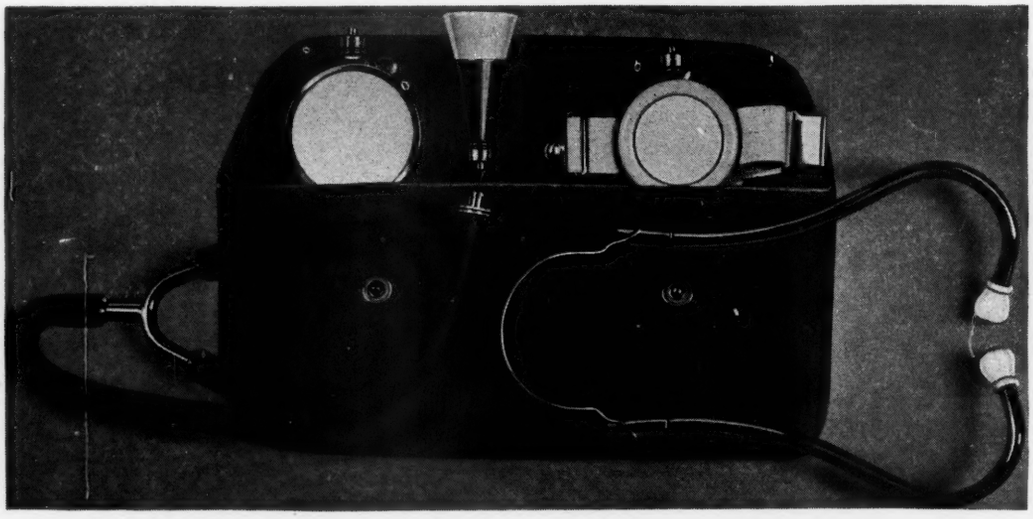

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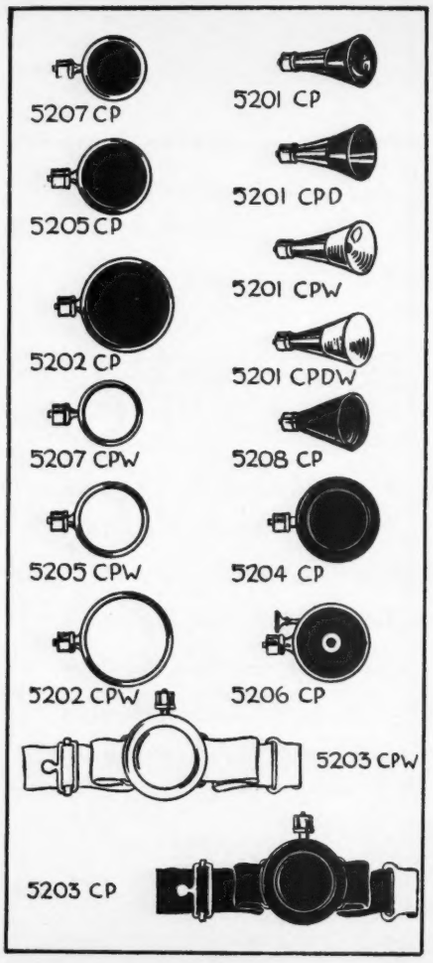

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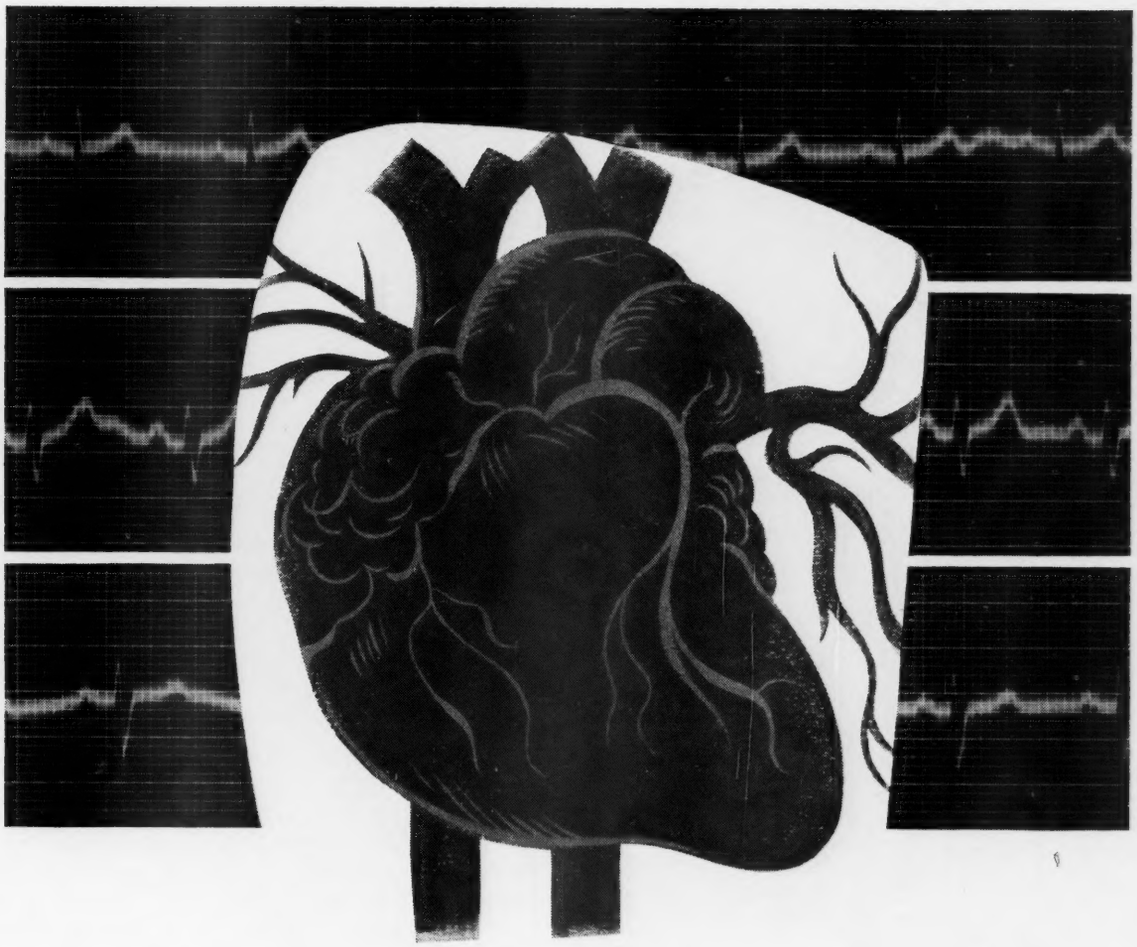

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Carraway, B. M. (1939) Pentothal Sodium with Nasal Oxygen; Anesthesia and Analgesia, 18:259

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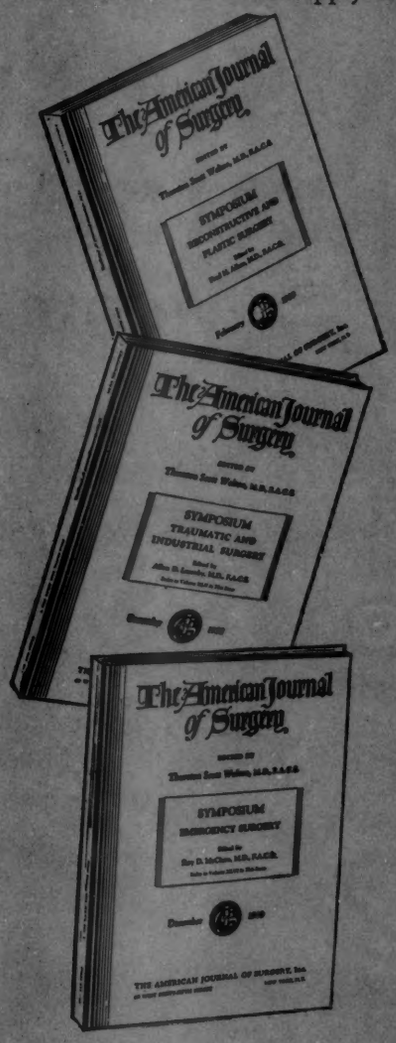
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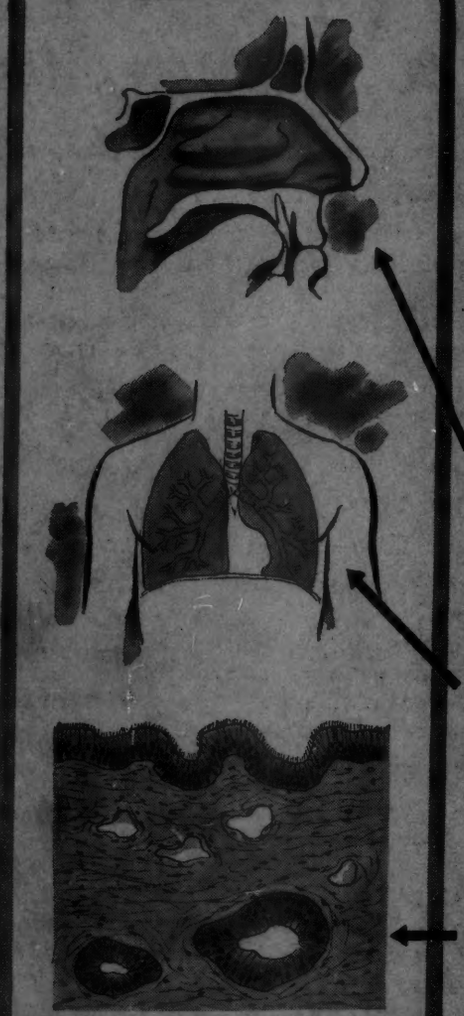

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